# Modeling of Some Physical Properties of Zirconium Alloys for Nuclear Applications in Support of UFD Campaign

Michael V. Glazoff

August 2013



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August 2013

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# **UFD** Campaign

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### **ABSTRACT**

Zirconium-based alloys Zircaloy-2 and Zircaloy-4 are widely used in the nuclear industry as cladding materials for light water reactor (LWR) fuels. These materials display a very good combination of properties such as low neutron absorption, creep behavior, stress-corrosion cracking resistance, reduced hydrogen uptake, corrosion and/or oxidation, especially in the case of Zircaloy-4. However, over the last couple of years, in the post-Fukushima Daiichi world, energetic efforts have been undertaken to improve fuel clad oxidation resistance during off-normal temperature excursions. Efforts have also been made to improve upon the already achieved levels of mechanical behavior and reduce hydrogen uptake. In order to facilitate the development of such novel materials, it is very important to achieve not only engineering control, but also a scientific understanding of the underlying material degradation mechanisms, both in working conditions and in storage of used nuclear fuel.

This report strives to contribute to these efforts by constructing the thermodynamic models of both alloys; constructing of the respective phase diagrams, and oxidation mechanisms. A special emphasis was placed upon the role of zirconium suboxides in hydrogen uptake reduction and the atomic mechanisms of oxidation. To that end, computational thermodynamics calculations were conducted concurrently with first-principles atomistic modeling.



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# Modeling of Some Physical Properties of Zirconium Alloys for Nuclear Applications in Support of UFD Campaign

# 1. INTRODUCTION

Zircaloy-2 (hereafter referred to as Zr-2) was originally developed to improve corrosion resistance of the Zircaloy-1 (i.e., Zr-2.5%Sn) [1-3, 5]. This goal was achieved by adding minor amounts of Cr, Ni, and Fe. It was used, with significant success, as the cladding material to retain nuclear fuel in boiling water reactors (BWRs) and, to a lesser extent, pressurized water reactors (PWRs). To avoid using very expensive "iodide" zirconium zirconium sponge was recommended for alloying purposes; the Zr-2 chemical composition and the maximum level of allowable impurities (specified for reactor-grade material), are presented below, in wt.% [1, 6]:

Zr-2: Zr, (1.2-1.7)% Sn, (0.07-0.2)% Fe, (0.03-0.08)% Ni, and (0.05-0.15)% Cr. The following level of impurities is allowed for Zr-2: Al - 0.0075%; B - 0.00005%; C - 0.0270%; Cd - 0.00005%; Co - 0.0020%; Cu - 0.0050%; H - 0.0025%; Hf - 0.0200%; Pb - 0.0130%; Mg - 0.0200%; Mn - 0.0050%; N - 0.0080%; Na - 0.0020%; Si - 0.0120%.

The principal goal of these alloying elements in Zr-2 was to neutralize the detrimental effect on corrosion resistance of the impurities, especially—nitrogen, aluminum, and carbon, [1, 6]. However, this alloy had a hydrogen uptake higher than the level required for work in pressurized light water reactors, [1. It is mostly for this reason that the Zr-4 alloy was developed, [1]. The principal thought was to eliminate nickel as it demonstrated the highest ability to serve as a hydrogen getter. Consequently, its alloy composition window was selected as follows: Zr-4: Zr, (1.2-1.7) % Sn, (0.18-0.24) % Fe, (0.07-0.13)% Cr. [7]. As a result, the hydrogen uptake was reduced almost by a factor of four.

One important issue that has not received attention in the literature is: what does the expression "hydrogen uptake" actually mean? Is this the amount of hydrogen that could be dissolved in the Zr-based solid solution at a given temperature, or the overall hydrogen distributed among solid solution, precipitates of second phases (typically Zr<sub>2</sub>M, FCC, and hexagonal C14 Laves phases [8, 9]), and the hydride phase? If the former definition is correct, then the hydride solvus curve should be different for Zr-2 and Zr-4 as a function of temperature. If, on the other hand, the term "hydrogen uptake" is related to the rate of sorption of hydrogen in a given alloy, then one needs to understand the mechanism of such adsorption impediment for Zr-4.

The issue of hydrogen is closely connected to that of zirconium alloys oxidation. As it will be demonstrated below with atomistic simulations, the formation of certain oxygen bearing zirconium compounds, especially monoclinic  $ZrO_2$  and suboxide  $Zr_3O$  [10-12], at the interface "cooling water – alloy surface" is critical to preventing hydrogen pickup. Under normal working conditions the primary source of hydrogen is radiolysis of water. Under catastrophic temperature excursions above  $800^{\circ}C$ , zirconium will be oxidized by water forming  $ZrO_2$  and hydrogen. We will be concerned mostly with the conditions realized during spent nuclear fuel storage, so the temperature range of interest will be below  $400^{\circ}C$ .

In general, zirconium is thermodynamically unstable with respect to its oxidation process even at room temperatures [13, 14]. The necessary condition for the ZrO<sub>2</sub> formation is that the partial pressure of O<sub>2</sub> must be higher than the dissociation pressure of the ZrO<sub>2</sub> at a given temperature, [13]. Since this condition is satisfied even in deep vacuum, there will always be a thin layer of oxide on the surface, of the order of 2nm to 5nm. Another source of potential problems is the metastability of Zr and its alloys with respect to oxidation by fresh and/or spent nuclear fuel, UO<sub>2</sub>, [14].

Consequently, in this paper a research effort was made to understand the following issues: (1). Construction of self-consistent thermodynamic models of hydrides for pure Zr, Zr-2, and Zr-4; (2).

Understanding the phase equilibria and thermodynamic properties in the Zr-O system and interaction of Zr-2 and Zr-4 with oxygen, paying special attention to the role of zirconium suboxides in the overall reduction of hydrogen pickup; (3). Elucidating the role of microstructure in the reduction of hydrogen uptake; and (4). Providing specific recommendations on safe dry storage of spent nuclear fuel (SNF).

The paper is organized as follows. In Section 2, the employed computational methods, i.e., first principles atomistic simulations and computational thermodynamics of materials are described. Section 3 describes the equilibrium aspects of hydride formation in pure Zr, Zr-2, and Zr-4. Section 3 is devoted to the Zr-O system, its thermodynamic properties and phase equilibria. Special emphasis was made upon the protective role of  $Zr_3O$  in reducing the hydrogen uptake in Zr and its alloys. In Section 4 conclusions and recommendations for future research are provided.

# 2. OXIDATION AND HYDROGEN UPTAKE IN ZIRCONIUM, ZIRCALOY-2 AND ZIRCALOY-4: COMPUTATIONAL THERMODYNAMICS AND AB INITIO CALCULATIONS (by Michael V. Glazoff)

# 2.1 Computational Methods

In this work, *ab initio* first-principles, density functional theory (DFT) – based calculations and computational thermodynamics of materials (CALPHAD approach – stands for CALculation of PHAse Diagrams), [22-24]) were used. Their brief descriptions are given below.

#### 2.1.1 Ab Initio Calculations

The supercell total energy calculations were based on the generalized gradient approximation (GGA) for exchange and correlation, and plane waves [15]. We used the GGA functional of Perdew, Burke, and Ernzerhof (PBE) [16], which gives good results for chemisorption of molecules on transition-metal surfaces and similar processes. Projected Augmented Wave (PAW) scalar relativistic pseudopotentials [17, 18], and the VASP code [19] were used. The energy cutoff for the plane-wave basis was set at 500 eV, and all integrations over the Brillouin zone were done using the Monkhorst-Pack scheme with four k points in the relevant irreducible wedge. Inclusion of additional k points was found to have minimal effect on the total energy differences of interest.

We used two hcp supercells containing 54 atoms ( $3 \times 3 \times 3$  hcp unit cells) and 200 atoms ( $5 \times 5 \times 4$  unit cells). For each supercell, we relaxed all the atomic positions until the quantum-mechanical force on each atom became smaller than 0.02 eV/Å. Activation barriers were calculated using the nudged-elastic-band method, [20].

# 2.1.2 Computational Thermodynamics of Materials

The goal of computational thermodynamics is to establish a bridge between phase equilibria and thermodynamic properties of materials. To achieve that, one needs the conditions of equilibrium, as well as certain models for all solid, liquid, and gaseous phases participating in a given equilibrium. Even if such models are reliable and physically consistent, the problem of global optimization of the system free energy has to be solved. In turn, such problems require that significant computational power and efficient optimization algorithms are available to the researcher.

All of these conditions started to be realized in the beginning of the 1980s. Mats Hillert in Sweden (KTH) [22] supervised the development of the ThermoCalc and DICTRA software. Also, Hillert made very significant contributions to a number of useful thermodynamic models (theory of sub-lattices [22], energy compound formalism, the concept of para-equilibrium, etc. [22]. Other models were developed for different types of systems, including model of ionic liquids used in this work. Lukas et al. [23], Saunders and Miedownik [24] developed the generalized equilibrium conditions, (software BINGGS for binary systems). Liu used first-principles approach to obtain data necessary for thermodynamic simulations, [25]. Similar work developed, concurrently and independently, in Canada (A.D. Pelton and software FactSage) and in the US (the late Prof. Austin Chen, software PANDAT). As a result, it became possible to provide self-consistent descriptions of phase equilibria in multi-component systems and thermodynamic properties of materials [22].

In this work, commercial databases for zirconium alloys TTZR1 (ThermoTech Ltd.) and binary alloys TCBIN (ThermoCalc AB) were used. These databases and the ThermoCalc ver. S software were used to generate data on the thermodynamic properties of hydrides, in particular, partial molar enthalpy and entropy of hydrogen. The obtained results were consistent with the constructed phase diagrams and property diagrams. All results were critically evaluated in light of the existing experimental data.

### 2.2 Results and Discussion

# 2.2.1 Zirconium Hydrides and Hydriding of Pure Zr, Zr-2, and Zr-4

The formation of hydrides and the problem of hydriding were studied very extensively, [1-3, 26]. First principles calculations of the equilibrium crystalline lattice parameters, free energy of formation at different temperatures, and the phonon density of states were discussed by Blomquist and by Zhu et al., [35, 36]. A detailed overview of the problem of hydrogen solubility in Zr and its alloys was provided by Anghel [13]. The principal reason of this interest is that the formation of zirconium hydrides may cause such undesirable phenomena as hydrogen embrittlement and reorientation of hydrides during storage that may be detrimental to the overall mechanical properties of the fuel during transportation and handling prior to disposal [37-45]. Consequently, efforts were made to reduce hydrogen uptake via changes in alloy chemical composition, development of different coatings, thermo-mechanical treatments optimizing alloy microstructure (size distribution and number density of second phase particles, or SPPs) etc. [13], This becomes even more important as fuel burnup is extended. As burnup increases, so does the amount of radiation damage to the clad and more hydrogen is taken up by the clad [46]. This can affect the mechanical properties of the clad.

Zhang and Norton [47] have concluded that the maximal hydrogen uptake sites are located on grain boundaries and/or interfaces that facilitate heterogeneous nucleation of hydride compounds. Hydrogen tends to segregate to surfaces and interfaces (grain boundaries, cracks and other defects) in Zr. These hydrogen-rich areas are possible nucleation sites for hydrides. Moreover, oxygen in the  $\alpha$ –Zr matrix facilitates hydrogen segregation to the surfaces, [47]. Understanding the role of the different zirconium oxides and suboxides in the reduction of hydrogen uptake was the most important goal formulated in this study.

The equilibrium crystalline structures of hcp-Zr and its three hydrides are depicted in Figures 1 and 2, respectively. In all cases, the equilibrium lattice parameter(s) were determined by total energy relaxation technique of the lattice parameters and corresponding atomic positions.

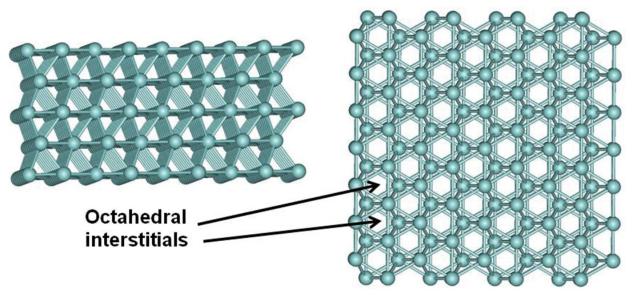


Figure 1. Hexagonal (hcp) Zr structure (different views): (a) in the direction perpendicular to the (0001) axes; (b) in the direction of the (0001) axes. Zr atoms are shown in cyan color; octahedral interstitials are indicated by arrows.

The low-temperature  $\alpha$ -phase of Zr has hcp structure characterized by the 2/1 ratio of tetrahedral and octahedral interstitial positions per unit cell. The lattice parameters were determined in this work as a = 3.2276 Å and c = 5.1516 Å, space group P63/mmc, see Figure 1.

The transport properties (diffusion) of hydrogen and oxygen atoms in Zr are directly related to the relatively large interstitial space that could be occupied by these atoms that are nearly "free" energetically in those spaces. Figure 2 shows the relaxed atomic structures for the equilibrium positions of O and H atoms in the Zr hcp structure. Oxygen always goes into octahedral interstitials because any other possible location will inevitably damage the Zr crystalline network and cause local rearrangement of Zr atoms. Neutral hydrogen atoms may also go into octahedral interstitials (interaction energy of H atom with Zr network is below 0.1 eV, i.e., almost negligible). However, it can also position itself in the middle of Zr-Zr bonds. In the latter case, hydrogen damages the Zr network by forming asymmetric Zr-H-Zr bridges or even attaching itself to only one Zr atom and leaving dangling bond defect at another Zr atom. However, this "damage" is not that significant as it would be if oxygen atom were placed in a similar position – the energy of Zr-H-Zr configuration is only 0.5 eV higher than that of the interstitial configuration. It means that although H would energetically prefer to be located at an interstitial position, metastable Zr-H-Zr configurations are also possible if the process is driven kinetically.

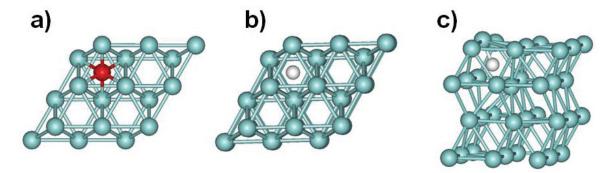


Figure 2. Positions of single oxygen and hydrogen in hexagonal (hcp) Zr structure: (a) O in the octahedral interstitial; (b) H in the octahedral interstitial; (c) H in the middle of the Zr-Zr bond. Zr atoms are shown in cyan, oxygen – in red, hydrogen – in white.

There are three distinctly different types of zirconium hydride structures described in the literature:  $\gamma$ -ZrH;  $\delta$ -ZrH<sub>1.66</sub> (which was modeled in this work as ZrH<sub>1.5</sub>) and  $\epsilon$ -ZrH<sub>2</sub> [35]. In Figure 3 we present the results of our first-principles calculations yielding the three energy-relaxed crystal lattice structures.

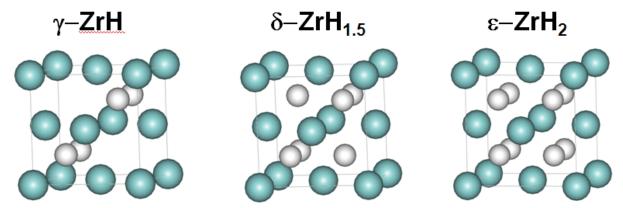


Figure 3. Relaxed crystalline structures of the three experimentally observed hydrides of zirconium: orthorhombic  $\gamma$ –ZrH (a=4.592 Å; c=4.492 Å); cubic  $\delta$ –ZrH<sub>1.5</sub> (a=4.775 Å) and tetragonal  $\epsilon$ –ZrH<sub>2</sub> (a=4.999 Å; c=4.433 Å).

The space groups of these hydrides are Cccm; Fm3m; and I4/mmm, respectively. It can be seen that very minor lattice distortions caused by the hydrogen atoms result in the change of the symmetry group(s) and in the value(s) of the lattice parameter(s) as one moves from one hydride to another. These results were obtained using a standard energy minimization procedure and agree well with the existing experimental data.

In Figure 4 the results of our thermodynamic modeling of the Zr-H phase diagram are presented and compared to the existing literature data, [48].

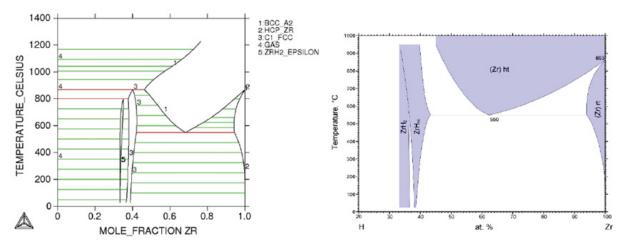


Figure 4 (a). Calculation using ThermoCalc; (b) experimental phase diagram [48]. Both diagrams agree well in establishing the phase fields of the  $\delta$ - and ε-hydrides with homogeneity ranges on the basis of the stoichiometric compounds ZrH<sub>1.5</sub> (experimentally established value is ZrH<sub>1.66</sub>, [35]).

The values of the Gibbs free energy computed at T=800~K are illustrated by Figure 5; these values lie in the range from -20,000 J/mol to  $\sim 8,000~J/mol$ . This reference range will be useful when we discuss existing data on partial molar enthalphy of hydrogen in different zirconium alloys, as well as for determining the driving forces of hydride formation, - the corresponding look-up tables could be used for phase-field calculations of zirconium hydride microstructure evolution.

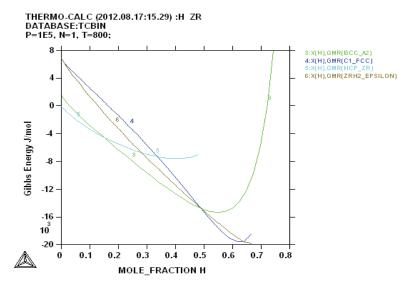


Figure 5. The Gibbs free energy of the several co-existing phases in the Zr-H systemas a function of the hydrogen mole fraction at 800 K.

The magnified diagram for the hydrogen mole fraction varying from 0 to 0.1 is given in Figure 6. It provides an estimate of the hydride dissolution temperature as  $550^{\circ}$ C corresponding to  $\sim 0.054$  mole fraction of hydrogen. Also, a distinctive feature of this diagram is the retrograde solubility above  $550^{\circ}$ C, with a minimum corresponding to  $\sim 600^{\circ}$ C. Again, these results correspond well to the existing experimental data [28, 30, and 48].

Proceeding in a similar way, we constructed the quasi-binary Zr-2 – hydrogen and Zr-4 –hydrogen property diagrams. Sometimes such diagrams are called isopleths as they correspond to

the case of constant sum of concentrations:  $(n_{Zr} + n_H = const)$ , thus allowing variation of the hydrogen concentration at the expense of zirconium, the principal alloying element.

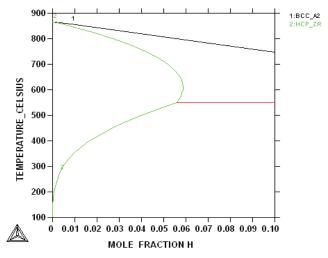


Figure 6. Fragment of the diagram in Figure 4(a) for low values of nH.

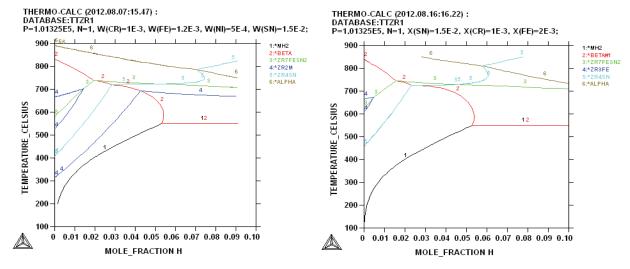


Figure 7. (a) Hydrogen isopleth for Zircaloy-2; (b) Hydrogen isopleth for Zircaloy-4

It is important to mention that in both equilibrium diagrams there are such phases present as Zr<sub>4</sub>Sn; Zr<sub>7</sub>FeSn<sub>2</sub>, and Zr<sub>3</sub>Fe, in addition to Zr<sub>2</sub>M and hydride phase. However, Zr<sub>4</sub>Sn and Zr<sub>3</sub>Fe have not been discovered in the equilirium microstructure of both alloys.

Experimentally, microstructural characterization of alloy Zr-4 was conducted by Vandersande and Bement [49]. These researchers identified the second phase particles in an annealed Zr-4 sample to be primarily the hexagonal, Laves-phase C14 Zr(Fe, Cr), type. Krasevec [50] found both hexagonal and fcc Zr- and Cr-bearing precipitates, in an annealed Zr-2 sample. Mukhopadhyay et al. [51] observed fine precipitates of the two types: cubic Zr<sub>2</sub>(Cr,Fe) with a hexagonal C14 type structure (structural type MgZn<sub>2</sub>) and the cubic C15-structure (prototype MgCu<sub>2</sub>).

Rao and Bangaru [52] studied the microstructures of heat treated samples of Zr-4 to understand the microstructural basis of nodular corrosion. These workers used samples annealed from the beta-phase field, as-received, and samples with microstructure on the basis fo the alpha-Zr. It was established that the first group of the samples possessed the best corrosion response. An advanced synchrotron study of second-phase particles (SPPs) in bulk zirconium alloys was conducted recently by Erwin et al., [53].

The list of equilibrium phases that can be taken into consideration in the TTZR1 database, includes both the hexagonal C14 Laves phase and the C15 cubic phases, but these phases were not observed in our equilibrium calculations.

The presence of the several compounds not found in experimental phase diagrams poses a question: should we determine the hydrogen solubility from these diagrams, or from metastable diagrams in which such phases as  $Zr_3Fe$ ;  $Zr_7FeSn_2$ ;  $Zr_4Sn$  get the status of "suspended?" We studied both possibilities. In fact, as far as the hydride solvus and the temperature of hydride dissolution reaction are concerned, we get results almost identically similar to those for the pure Zr-H phase diagram. The temperature of the hydride dissolution reaction was  $551^{\circ}C$  for Zr-2 and  $552^{\circ}C$  – for Zr-4. Given the experimental error in determining the temperature of phase transformation is of the same order, we can conclude that these results are identical.

On the other hand, if we construct metastable phase diagrams as described above, then the highest solubility point (for hydrogen in Zr) shifts toward lower values, i.e., for both alloys  $\sim$ 0.034 hydrogen mole fraction. The temperature of the non-variant reaction remains the same, i.e.,  $\sim$ 550°C.

This latter assumption contradicts the experimental evidence presented in [28] and in [30] that the equilibrium solubility maximum for Zr, Zr-2, and Zr-4 remains practically the same. In our calculations, it was around 0.058 hydrogen mole fraction for pure Zr; 0.056 – for Zr-4; and 0.054 – for Zr-2.

The thermodynamic properties evaluation for the Zr-H system was limited to the partial molar enthalpy of hydrogen in the alpha- and beta-phases. This property is very sensitive to the formation of different complexes and tendency to atomic ordering or segregation. Besides, it was evaluated experimentally and reported in at least two articles [30, 54, and 55].

The partial molar enthalpy of hydrogen in the binary Zr-H system was assessed according to the well-known expression [22]:

$$H_{H} = H_{m} + \left(\partial H_{m} / \partial x(Zr)\right)_{T,P} - x(Zr) \cdot \left(\partial H_{m} / \partial x(Zr)\right)_{T,P}$$
(1-1)

In expression (1),  $H_m$  stands for the molar enthalpy of the system; x(Zr) represent the molar fraction of zirconium, and  $H_H$  is the partial molar enthalpy of hydrogen for different phase fields of the diagram at  $650^{\circ}$ C.

The values of partial molar entropy of hydrogen were calculated using the following expression:

$$S_H = -\frac{\partial \mu(H)}{\partial T} \tag{1-2}$$

In expression (2) the chemical potential of hydrogen,  $\mu(H)$ , is assessed with respect to its references state [22].

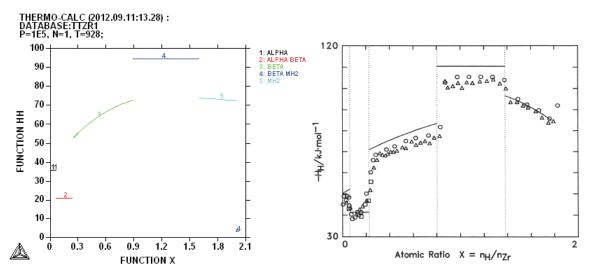


Figure 8. Partial molar enthalpy of hydrogen in different phases as a function of the x(H)/x(Zr) and its comparison to experiment [54] and the results of thermodynamic computations in [55].

The agreement between our results and the results reported in [54, 55] is quite good. At the same time, the experimental results reported in [23] give values of H<sub>H</sub> one order of magnitude lower. For example, it was reported that for pure Zr, at temperature 650°C,  $H_H$  is around -260 kJ/mol. These results are difficult to reconcile with the ones reported in [54] and in this study. For alloys Zr-2 and Zr-4 somewhat lower values were obtained in [23]: -250 kJ/mol for Zr-4, and -240 kJ/mol for Zr-2. In this work, it was problematic to conduct the assessment of thermodynamic properties because of the presence of equilibrium phases that were not observed experimentally in past work.

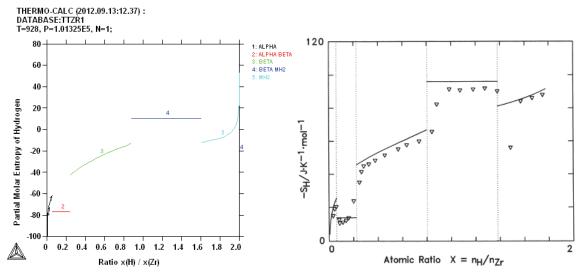


Figure 9. Partial molar entropy of hydrogen: comparison of the results of modeling (left) and experimental data [16]; black solid line –the results of thermodynamic assessment in [55] and experimental work [54].

The results for partial molar entropy of hydrogen are presented in Figure 9 below. There is a qualitative agreement between the experimental data reported in [54] and our calculations. There is a significant shift in the absolute value of  $(-S_H)$ . However, partial molar entropy, being a second derivative of the Gibbs free energy with respect to concentration and to temperature, is notoriously unstable with respect to small errors in the input experimental information. Suffice it to say that in [23] the *values of different sign* were reported for the partial molar entropy of hydrogen of the alpha-phase. This implies only that the reassessment of the Zr-H diagram should be done to get a better agreement for nuclear Zr-bearing alloys.

#### 2.2.2 Oxidation

Zirconium-based alloys represent the main structural materials used in light water cooled nuclear reactors (PWRs and BWRs). For these materials, the formation of a thin oxide layer with long-term kinetic stability in working reactor conditions is very important [1]. A detailed study of the diffusion of oxygen in zirconium was published by Cox, [56].

When atoms of hydrogen or oxygen occupy interstitial lattice positions between atoms of a zirconium, they form a solid solution(s). In the case of oxygen, its solubility in zirconium is quite large, about 29 at% at ambient temperature [57]. This is a consequence of the relatively large size of the octahedral sites in the hcp lattice (see Figure 1). The 29 at% of oxygen approximately corresponds to filling from 1/4 to 1/3 of interstitials in each layer of the hcp structure. One could expect that when this critical concentration of dissolved oxygen is reached, oxygen atoms and remaining interstitials will start to form some ordered structures, which results in significant reconstruction of hcp network and the onset of zirconium oxide formation. This is indeed the case [4, 58-60], and the significance of such order-disorder transformations for the reduction of hydrogen uptake will be discussed below.

There are several crystallographic modifications of  $ZrO_2$ . One is monoclinic, with the space group  $P2_1/c$  and four atoms per unit cell. The lattice parameters (in Å) are a = 5.1501(2); b = 5.2077(2); and c = 5.3171(2). It does not have oxygen deficiency, i.e., the monoclinic modification is stoichiometric. This is the low temperature modification of  $ZrO_2$  present in nature as a rare mineral, *baddeleyite*. The tetragonal modification is characterized by the space group  $P4_2/nmc$ , [60] and lattice parameters a = 3.6067 Å; b = 3.6067 Å; and c = 5.1758 Å, [61]. The occupancy factor for oxygen atoms in the tetragonal modification is  $\sim 0.984$ . This implies the tetragonal modification  $ZrO_{2-\delta}$  has an oxygen deficiency of  $\delta = 0.031$ . It is for this reason that stabilization of zirconia is necessary with lower valence oxides such as  $Y_2O_3$ . Finally, there is a cubic zirconia modification,  $FCC_2O_3$ , with space group Fm-3m, and lattice parameter a = 5.09 Å. The experimental and calculated Zr-O phase diagrams are presented in Figure 10 below.

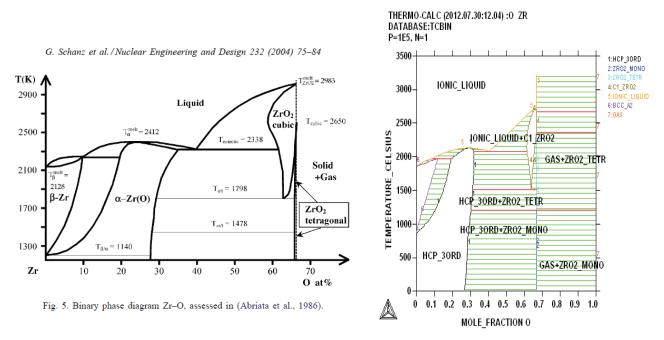


Figure 10. Experimental [57] and computed phase diagram Zr-O.

We computed this phase diagram with the ThermoCalc software and using the TTZR1 and TCBIN databases by ThermoTech Inc. and ThermoCalc AB, respectively. It can be seen that there is practically a one to one correspondence between the two diagrams. It should also be noted that the model of ionic liquids was used in this work to represent the behavior of the liquid phase. The results of calculation of the partial molar enthalpy of hydrogen in different phases at 650°C are presented in Figure 11.

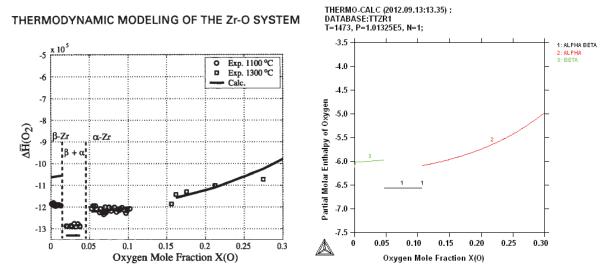


Figure 11. Partial molar enthalpy of oxygen: experimental data [62, 63], the results of assessment in [64], and the present work.

This last calculation is a good test for the physical sense of the model. Indeed, the partial molar enthalpy of the beta-phase is higher than that of the (alpha + beta) phase field. As it was demonstrated in [64], if Henry's law is followed for the beta phase, then the following relation must hold up to the point of maximum oxygen solubility (saturation):

$$\mu(O)_{\beta} = \mu(O)_{\beta/\alpha} + RT \ln \left( \frac{x(O)}{x(O)_{sat.}} \right)$$
(2-3)

Then, for the partial molar enthalpy of oxygen within the beta phase we will get [64]:

$$\overline{H}_{O_2,\alpha} = \frac{2\frac{\partial \mu(O)_{\beta/\alpha}}{\partial T}}{\partial (1/T)} = \overline{H}_{O_2,\beta/\alpha} + 2RT^2 \frac{dX_O/dT}{X_O}$$
(2-4)

Looking at the experimental and computed phase diagram of the Zr-O system, we observe that  $dX_O/dT > 0$ , i.e., the partial molar enthalpy of oxygen for the (beta + alpha) region must be smaller (more negative) than that of the alpha-region, [64].

As described in the literature, two distinct oxidation periods have been observed for Zr, pre-transition and post-transition [1]. The pre-transition period is characterized by a decreasing oxidation rate and an adherent, protective film with a shiny black appearance. During the post-transition period a constant but greater oxidation rate was observed, and a less protective film formed that had a white flaky appearance. The time required to reach transition is both temperature and time dependent [1].

This change in coloration could serve a possible qualitative indicator of the undesirable transition from ZrO<sub>2</sub> to Zr(OH)<sub>4</sub>\*nH<sub>2</sub>O. Indeed, in the precious and semi-precious stone industry a process of blackening of metallic zirconium is described, which results in beautiful shiny black coloration [65]. The raw piece is made of pure zirconium, which is then subjected to heating in a controlled oxidizing atmosphere. During this process the color changes to bronze, then to blue, then to yellow and other colors as the heat-up continues according to a prescribed thermal schedule. The initial very pure blue color is caused by the constructive interference of the light waves. As the process continues, the continuing oxidation results a second order of colors that is formed over the first, and so on. Eventually, as the oxide layer gets thicker, shiny black surface appears. These changes in coloration could be explained similar to an earlier effort by the authors to describe omni-directional coloration of metals via light scattering from textured metallic surfaces, [65].

On the other hand, hydroxides of Zr(OH)<sub>4</sub>\*nH<sub>2</sub>O are more flaky and white, [66]. This provides a possibility to measure the degree of oxidation of the underlying Zr-alloy nuclear fuel clad using a photo colorimeter.

While the phenomenon of zirconium oxidation / corrosion is very complex, the factors affecting it have been studied extensively. In particular, it is known [1] that *impurities* such as nitrogen, carbon, and aluminum have a pronounced deleterious effect on the corrosion resistance of Zr-2.

*Heat treatment and Irradiation* also affect corrosion of Zr quite substantially. Detailed synchrotron studies of second phase particle SPP precipitation and dissolution as a function of irradiation dose were reported in [67, 68]. For example, Rudling and Wikmark established that there is an optimum range for size distribution and composition of SPPs, which is correlated with the exposure conditions. They reported optimum size distributions for SPPs in the range of approximately 25-175 nm for BWR conditions. Optimum SPP Fe/Cr ratios of 0.6-1.2 and Fe/Ni ratios of 0.9-1.0 have also been found [69].

**Porosity development** in the oxide layers generates easy diffusion pathways for molecules during oxidation. A considerable contribution of molecular oxygen to total oxygen transport in zirconia has been observed at temperatures up to 800°C. Effective pore sizes in the nanometer range were found for pre-transition oxides on Zircaloy-2. Inward oxygen transport can be promoted by oxygen dissociating elements such as Fe-containing second phase particles. The results suggest furthermore that a proper choice of the second-phase particles composition and size distribution can lead to the formation of dense oxides, which are characterized by low oxygen and hydrogen uptake rates during oxidation.

Concerning *oxygen diffusion via grain boundaries*, differences of several orders of magnitude between grain boundary conductivity and the conductivity inside the grains have been reported (grain boundary diffusion >> diffusion via/in grains) [70]. For oxide scales grown on Zr-based alloys at temperatures around 400°C, two crystallographic phases of zirconia have been reported: monoclinic and tetragonal. The monoclinic phase is stable at low temperatures and is, as expected, the dominating phase in the oxide scale (see the Zr-O phase diagram in Figure. 10). The tetragonal phase can also be found close to the oxide/Zr(O) interface (stabilized by the high compressive stress and grain size < 30nm) and within the oxide scale near the interface between the partially oxidized intermetallics and the bulk oxide. The oxygen vacancy concentration in zirconia, which influences the transport of oxygen through the oxide lattice, is higher in the tetragonal phase (2-3 mol %) than in the monoclinic phase (<2 mol %). The tetragonal  $\rightarrow$  monoclinic phase transformation takes place with a volume increase of about 7% and has a significant impact on the corrosion behavior of Zr-based alloys [71].

In [72], it was established that the second-phase particles, or SPPs, have a high affinity for hydrogen and act as short-circuit pathways for hydrogen transport through the oxide protective layers. Hydrogen can easily diffuse through these thin oxide scales via metallic SPPs towards the metal substrate.

An interesting feature of the crystalline Zr at room temperature is an efficient repelling of interstitial atoms (H or O) from each other. The collective behavior of interstitial oxygen atoms in hcp-Zr was recently described by Ruban et al. [73]. Their calculations indicated that although interstitial oxygen atom produces just a minimal shift of the surrounding Zr atoms, it is energetically unfavorable (by about 0.5 eV) when two O atoms occupy any neighboring interstitial positions. The authors of [73] later used these atomic-scale energies in their Monte Carlo simulations of thermodynamically preferred interstitial configuration(s). We repeated these calculations and confirmed their validity. On this basis one could hypothesize that before the complete reconstruction of Zr network, oxygen might form an intermediate "checker board" configuration, and in each layer the maximal atomic concentration of oxygen would be 25 %. This is quite close to the experimental value of 29 at. %, and to the Zr<sub>3</sub>O stoichiometric suboxide [4, 58-60]. The discrepancy in the numbers may be explained by the kinetic effects that were not taken into account in this study. For even larger oxygen concentrations, the Zr-O structure should undergo a total reconstruction, and further oxidation will eventually result in the formation of the ZrO<sub>2</sub>.

Another interesting feature of the  $\alpha$ –Zr structure is an impossibility of more than one atom (hydrogen or oxygen) to stay in one interstitial position. Figure 12 shows the relaxed atomic configuration for hydrogen molecule placed in a Zr octahedral interstitial; the two hydrogen atoms could not "coexist" in one octahedral interstitial position and eventually move to different interstitials. Therefore, one cannot expect hydrogen gas formation and/or hydrogen blistering as is observed at Al/Al<sub>2</sub>O<sub>3</sub> interfaces; also, one cannot expect that hydrogen molecule could be positioned as a whole (as in Si and/or SiO<sub>2</sub>) into hcp Zr crystalline lattice. At low oxygen concentrations hydrogen is unlikely to form any additional complexes except reconfiguring Zr network by forming asymmetric or broken Zr-H-Zr bonds.

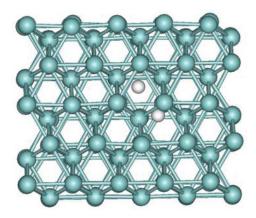


Figure 12. Relaxed configuration for two hydrogen atoms that were initially put in one octahedral interstitial (as H2 molecule). Zr atoms are shown in cyan, hydrogen – in white.

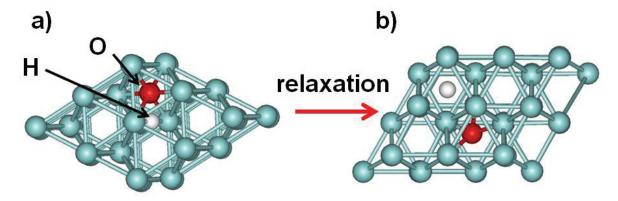
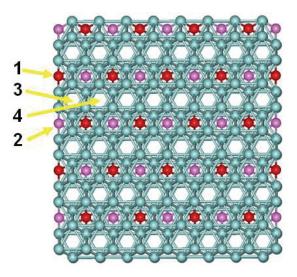


Figure 13. Relaxed configuration for H and O atoms. Initially oxygen atom was put in octahedral interstitial, and H atom – in the middle of a neighboring Zr-Zr bond. Zr atoms are shown in cyan, O – in red, H – in white.

Oxygen and hydrogen atoms also repel in the Zr hcp network. Figure 13 demonstrates how the energy relaxation of the original configuration for H and O complex actually takes place. Initially, an oxygen atom was positioned in the middle of an octahedral interstitial, while the H atom was positioned close to the neighboring Zr-Zr bonds. Relaxation forces these two atoms to move into the neighboring interstitial position instead of forming a complex within one interstitial. This is understandable; oxygen is strongly electronegative and has tendency to oxidize Zr (pull electrons away from neighboring metal atoms). Hydrogen in Zr solid solution exhibits negative valence and tends to form zirconium hydrides. Apparently, oxygen is a much stronger oxidant than hydrogen, and when oxygen is present in some interstitial, hydrogen positioned in the vicinity has no chance to find electrons at the surrounding Zr atoms. Therefore, it cannot attach itself to surrounding metal atoms and redirects itself into a neighboring interstitial that is still not occupied by oxygen.



**Figure 14** The "checkerboard" configuration for O atoms in octahedral interstitials. Zr atoms are shown in cyan, O in the first layer – in red, O in the second layer – in pink. Four non-equivalent groups of interstitials are indicated by numbers and yellow arrows.

Figure 2-14 illustrates the formation of the "checkerboard" configuration. In the first layer (oxygen atoms are shown in red), O is arranged in such a way that it does not occupy any two nearest neighboring interstitials. In the second layer (O atoms shown in pink), the intra-layer configuration should be similar. However, it has to shift with respect to the configuration in the first layer because we should avoid neighboring O atoms in the direction parallel to the (0001) axis of the hcp structure. In the second layer, oxygen could occupy interstitials of the type 3 and 4 with the same probability. In the third layer, several possibilities to arrange O atoms in checkerboard structure become available again, and so on. An important conclusion that comes from such a construction is that after several layers of octahedral interstitial are occupies with oxygen in concentration close to the critical (25 at. %), all the direct paths through hcp structure oriented along the (0001) direction for hydrogen atoms will be blocked by shifted checker board oxygen layers, and in order to migrate in the structure, any additional hydrogen atom will need to migrate not only in the (0001) direction but also laterally within the hcp Zr layers.

#### 2.2.3 Suboxides of Zirconium

Suboxides of transition metals such as titanium, zirconium, vanadium, etc., were discovered in the early 1960s [4, 58-60]. At temperatures between (about) 300°C and 900°C various ordered phases have been reported [5]. Octahedral interstitial ordering of oxygen increases the microhardness [58] and embrittlement [74], and therefore, promotes stress corrosion cracking. However, as it will be demonstrated later, oxygen can be very beneficial for reducing the hydrogen uptake under certain conditions, [71].

Order-disorder transitions in the zirconium – oxygen system were studied using heat capacity measurement for alloys with O/Zr ratios of 0.16 and 0.24 at 200°C – 700°C [75]; and alloys with O/Zr ratios of 0.0, 0.10, 0.13, and 0.24, at 52°C – 632°C. In particular, a high degree of long-range ordering was achieved in samples that were cooled from 350°C to 250°C, during a period of about one month. This clearly indicates that a high mobility of oxygen is observed in the  $\alpha$ –Zr matrix even at such modest temperatures [61]. These temperatures are directly relevant to the conditions of the used nuclear fuel storage and so is the formation of sub-oxides.

Inside the metal, oxygen is randomly distributed in octahedral interstitial positions up to a concentration of 0.33 mole fraction of O. Yilmazbayhan et al. [76] identified the formation of ordered suboxides ( $Zr_3O$ ) at the oxide /  $\alpha$ –Zr interface underneath the oxide and ahead of the oxidation front, by using microbeam synchrotron radiation diffraction. Oxygen uptake has a hardening effect on the Zr matrix, this effect is actually used in one of the novel Zr-Nb-O nuclear alloys, "M5 $^{TM}$ ". Cox [5] established that at temperatures around 400°C, less than 10% of the reacting oxygen is expected to dissolve into the metal substrate. He proved experimentally that preferential dissolution of oxygen, from the already formed oxide layer, takes place along the grain boundaries of Zr accompanied by the formation of arrays of pores in the oxygen-depleted grain boundaries (oxide) just above the metal substrate. These defective grain boundaries are possible open porosity development sites.

A clear correlation was found between oxide-metal interfacial microstructure and protective nature of the oxide (when interfacial structure is present, oxide is protective, when it is not present, oxide is not protective) [10-12, and 76].

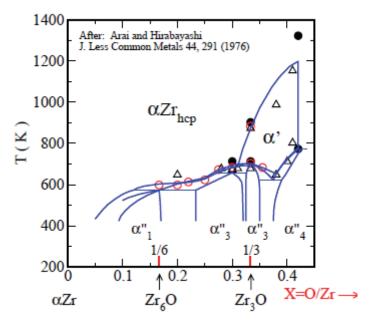


Figure 15. Experimentally constructed isothermal cross-section for the Zr-O-H phase diagram at 700°C, [61 and 75].

The structure of the oxide–metal interface is of great interest to understanding the mechanism of oxide growth and the differences between the protective and non-protective oxides. As it was demonstrated in [10-12], the protective alloys always exhibit extra peaks in the diffraction scans obtained near the oxide–metal interface region. These peaks have been associated with two different phases found in that region in the protective oxides:

- (i) A highly oriented tetragonal phase that has been hypothesized to be a crystallographic precursor of the monoclinic phase observed in the bulk of the oxide.
- (ii) <u>The formation of the sub-oxide phase  $Zr_3O$ .</u> This phase has also been seen at the oxide-metal interface by various researchers in oxides formed in Zr alloys at low temperature [77-82]. In particular, the diffraction pattern from synchrotron radiation shows strong  $Zr_3O$  peaks in a two to three micron region next to the oxide-metal interface corrosion.

Summarizing these results, characteristic differences seem to exist in the oxide—metal interface regions of protective and non-protective oxides. In particular, the presence of two interfacial oxide phases, a highly oriented tetragonal phase and a sub-oxide phase was associated with protective behavior uniform is deemed critical for the reduction in hydrogen pick-up. These results stimulated further first-principles calculations aimed at understanding the atomic mechanisms of such protection. These results are presented in the next Section.

# 2.2.4 Interstitial Oxygen and Hydrogen Solid Solutions

To understand the migration mechanisms of hydrogen in zirconium suboxides, migration barriers for oxygen and hydrogen in interstitial solid solutions were calculated using the nudged elastic band approach [83]. It was established that, unlike in pure Zr, inside the zirconium suboxide lattice the migration barrier for moving oxygen atom from one octahedral interstitial to another is very high (>2 eV). In turn, this implies that oxygen atoms are not mobile at moderate temperatures (below  $600 - 800^{\circ}$ C). A high migration barrier for oxygen in a suboxide is not surprising; it follows immediately from the simple geometric arguments (comparison between Zr-O and Zr-Zr bond lengths). Indeed, while an oxygen atom is put in some octahedral interstitial, it will stay there before either the temperature increases or the hcp Zr network significantly changes due to increase of oxygen atoms concentration above the critical value that hcp network can still tolerate. From the thermodynamics point of view, the checkerboard oxygen ordering (Figure 14) is energetically favorable. However, if because of kinetic reasons two oxygen atoms will become neighbors, their rearrangement towards an energetically favorable configuration will develop on a very slow time scale. Therefore, because of kinetics we could expect checkerboard distortions in the "real" suboxide systems.

Apparently, ordering of low-mobile oxygen atoms in Zr<sub>3</sub>O changes the dynamics of hydrogen propagation through this class of materials. Assuming that the hydrogen concentration gradient is directed along the (0001) axis, the following two modifications of the original hcp Zr matrix by oxygen are realized. First, the oxygen checkerboard arrangement shuts down "vertical" channels for hydrogen propagation along the (0001) axis. Moving along each of these, originally preferable migration paths, hydrogen will interact inevitably with oxygen atoms (this interaction is repulsive) positioned along this path. It means that the trajectory will be different than a straight line, i.e., it will become longer by necessity. Secondly, migration barriers for hydrogen between two octahedral interstitials increase when an oxygen atom is present in the neighboring interstitial. In the absence of oxygen, the migration barrier between two interstitials was determined to be about 0.6 eV, in agreement with earlier calculations. On the other hand, when oxygen is present in the neighboring interstitial, this barrier increases to 0.9 eV. Therefore, in addition to increasing the length of hydrogen migration paths, a presence of oxygen increases hydrogen migration barriers. Both factors are unfavorable for hydrogen migration and it explains why hydrogen will propagate slower in Zr<sub>3</sub>O than in pure zirconium.

Another interesting observation is that in the vicinity of oxygen atoms trapped in octahedral interstitials, hydrogen might migrate by another mechanism, namely through the middle of Zr-Zr bonds. In such a case, H atom distorts the Zr-Zr bond, forms the asymmetric Zr-H-Zr configuration, and eventually may break the original Zr-Zr bond. This process might be considered a precursor to the formation of stoichiometric hydride. Bond breaking will modify the hydrogen migration process even further, in favor of its' slowing down.

#### 2.2.5 CONCLUSIONS AND RECOMMENDATIONS

In the first part of this report we presented the results of computational thermodynamics and first-principles atomistic studies of the processes of hydrogen uptake and corrosion of zirconium and its alloys, including the detailed calculations of the Gibbs free energy of the competing phases in the Zr-H system at different temperatures (see Appendix). It was established that for pure Zr, alloys Zr-2 and Zr-4 the differences in hydrogen uptake could not be explained using thermodynamic arguments as the hydrogen solvi and hydrogen saturation points were practically the same in all three materials: temperature of hydride dissolution 550°C and ~0.056 hydrogen molar fraction. A conclusion was made that to understand the mechanisms of reduced hydrogen uptake rates, it was necessary to understand the kinetics of the hydrogen diffusion process and the role of the Zr<sub>3</sub>O suboxide forming underneath the layer of ZrO<sub>2</sub> at the depth of about 2 to 3 microns. This work was done using the first principles calculations, which demonstrated that the formation of Zr<sub>3</sub>O seems to be critical for reducing hydrogen diffusion of bulk Zr alloy. In turn, this implies that the cladding temperature in storage should not exceed 360°C, when the disordering reaction takes place accompanied by the formation of the disordered Zr-O solid solution. This conclusion is based upon the detailed analysis of the corresponding portion of the Zr-O phase diagram and our first-principles atomistic calculations.

These results have direct application to phase-field simulations of the zirconium hydride microstructure evolution and reorientation (data on the driving forces for hydride formation in the form of a look-up table).

More accurate modeling by kinetic Monte Carlo simulations of these order-disorder transformations and their role in slowing down the hydrogen uptake in nuclear zirconium alloys would have important implications for drying and, possibly even, alloy development.

Also, a detailed work on the development of self-consistent phase diagram region corresponding to these transformations should be conducted on the base of data generated from first-principles calculations on the temperature dependence of the free energy of the suboxide formation and not the semi-empirical Miedema rules, [64].

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## APPENDIX. THERMODYNAMIC PROPERTIES OF DIFFERENT PHASES

## IN THE Zr-H SYSTEM AT DIFFERENT TEMPERATURES

**Table A1** Gibbs thermodynamic potentials of different phases in the Zr-H system at 300°C (in J/mole)

		nic potentials of				<u>`</u>
X(H)	GMR(GAS)	GMR(IONIC_LIQ)	GMR(BCC_A2)	GMR(C1_FCC)	GMR(HCP_ZR)	GMR(ZRH2_EPS)
0.99975	94.42769	399892.2	11947.52	-28551.1	-11064.1	-30276.6
0.994546	2100.338	397727.4	11947.52	-28551.1	-11064.1	-30276.6
0.969546	11852.58	387562.9	11947.52	-28551.1	-11064.1	-30276.6
0.944545	21663.18	377515.2	11947.52	-28551.1	-11064.1	-30276.6
0.919546	31503.19	367526.2	11947.52	-28551.1	-11064.1	-30276.6
0.894545	41363.64	357578.1	11947.52	-28551.1	-11064.1	-30276.6
0.869546	51240.01	347661.9	11947.52	-28551.1	-11064.1	-30276.6
0.844546 0.819545	61129.58 71030.52	337772 327905	11947.52 11947.52	-28551.1	-11064.1 -11064.1	-30276.6 -30276.6
0.794546	80941.56	318058.1	11947.52	-28551.1 -28551.1	-11064.1	-30276.6
0.769545	90861.74	308229.4	11947.52	-28551.1	-11064.1	-30276.6
0.746623	99964.98	299232.3	9739.014	-28551.1	-11064.1	-30276.6
0.744546	100790.3	298417.6	8485.626	-28551.1	-11064.1	-30276.6
0.721623	109900.8	289434.9	-2427.43	-28551.1	-11064.1	-30276.6
0.719546	110726.8	288621.5	-3208.64	-28551.1	-11064.1	-30276.6
0.696623	119844	279652.4	-10156.3	-28551.1	-11064.1	-30276.6
0.694545	120670.6	278840.1	-10656.6	-28551.1	-11064.1	-30276.6
0.671623	129794.2	269883.9	-15084.1	-28551.1	-11064.1	-30276.6
0.669546	130621.4	269072.8	-15399.6	-28551.1	-11064.1	-30276.6
0.664347	132691.4	267043.5	-16136.1	-28764.1	-11064.1	-30262.2
0.66431	132706.1	267029.1	-16141.1	-28766.9	-11064.1	-30261.5
0.646623	139751.3	260129	-18143.8	-29446.4	-11064.1	-29582.8
0.644545	140579	259319	-18334.2	-29470.5	-11064.1	-29485.6
0.639347	142650.4	257292.4	-18774.2	-29493.4	-11064.1	-29235.3
0.63931	142665	257278	-18777.2	-29493.4	-11064.1	-29233.5
0.621623	149714.8	250387.1	-19927.1	-29240.6	-11064.1	-28332.8
0.619546	150543	249578.1	-20031.1	-29183.2	-11064.1	-28223.8
0.614347	152615.8	247554.2	-20265.9	-29018.1	-11064.1	-27949.3
0.61431	152630.5	247539.9	-20267.4	-29016.8	-11064.1	-27947.3
0.596623	159684.7	240657.8	-20823.6	-28261.1	-11064.1	-26999
0.596623	159684.7	240657.8	-20823.6	-28261.1	-11064.1	-26999
0.594546	160513.4	239849.9	-20867.1	-28155.8	-11064.1	-26886.6
0.589347	162587.5	237828.6	-20958	-27879.4	-11064.1	-26604.9
0.58931 0.571623	162602.2 169660.7	237814.3 230941	-20958.6 -21096.7	-27877.4 -26820.7	-11064.1 -11064.1	-26602.9 -25639.7
0.569545	170490	230134.1	-21096.7	-26686.7	-11064.1	-25526.3
0.564347	172565.3	228115.3	-21086.7	-26343.9	-11064.1	-25242.4
0.56431	172580	228101	-21086.6	-26341.4	-11064.1	-25240.4
0.546623	179642.9	221236.3	-20928.3	-25108.1	-11064.1	-24273.4
0.544546	180472.7	220430.4	-20898.7	-24957.7	-11064.1	-24159.8
0.539347	182549.2	218414.1	-20815.6	-24577.3	-11064.1	-23875.6
0.53931	182563.9	218399.8	-20815	-24574.5	-11064.1	-23873.6
0.521623	189631	211543.6	-20445.7	-23245.4	-11064.1	-22906.8
0.519545	190461.3	210738.7	-20394.5	-23086.6	-11064.1	-22793.3
0.514347	192539.1	208724.9	-20259.9	-22687.5	-11064.1	-22509.4
0.51431	192553.8	208710.7	-20258.9	-22684.6	-11064.1	-22507.3
0.496623	199625.2	201862.9	-19739.5	-21313.3	-11160.1	-21542
0.494546	200455.9	201059	-19673	-21151.4	-11194.2	-21428.6
0.494546	200455.9	201059	-19673	-21151.4	-11194.2	-21428.6
0.489347	202534.9	199047.7	-19501.8	-20746.1	-11250.2	-21145.1
0.48931	202549.7	199033.4	-19500.6	-20743.3	-11250.5	-21143.1
0.478571	206845.2	194880.2	-19128.1	-19906	-11295.7	-20557.7
0.471623	209625.2	192194	-18874.8	-19365.4	-11294.7	-20179.1
0.469546 0.464347	210456.5	191391.1	-18797.4	-19204	-11291.1	-20066
	212536.8 212551.5	189382.3	-18600.5 -18599.1	-18800.9 -18798.1	-11276.2 -11276.1	-19782.8
0.46431 0.453571	212551.5	189368.1 185220	-18599.1 -18179	-18798.1 -17969.7	-11276.1 -11223.3	-19780.8 -19195.9
0.446623	219631.3	182537.2	-17898.7	-17437.3	-11223.3	-19195.9 -18817.6
0.444545	220463	181735.3	-17813.8	-17278.8	-11160	-18704.5
0.439347	222544.6	179728.9	-17598.9	-16883.5	-11100	-18421.4
0.43931	222559.3	179714.7	-17597.4	-16880.7	-11116.7	-18419.4
0.428571	226860	175571.8	-17144.4	-16071	-11014.4	-17834.6
0.421623	229643.4	172892.4	-16845.5	-15552.5	-10939.7	-17456.2
0.419545	230475.6	172091.5	-16755.4	-15398.3	-10916.2	-17343.1
0.414347	232558.4	170087.7	-16528.3	-15014.3	-10855.1	-17059.9
0.41431	232573.2	170073.5	-16526.7	-15011.6	-10854.6	-17057.9
0.403571	236876.5	165935.8	-16051.5	-14227	-10718.7	-16472.6
0.396623	239661.6	163259.8	-15740.2	-13725.7	-10624.3	-16093.8
0.394546	240494.3	162459.9	-15646.7	-13576.8	-10595.2	-15980.5
0.389347	242578.4	160458.7	-15411.6	-13206.3	-10520.5	-15696.8
0.38931	242593.2	160444.5	-15409.9	-13203.7	-10520	-15694.8
0.378571	246899.2	156312.2	-14920.4	-12448	-10358.1	-15108.6
0.371623	249686	153639.6	-14601.3	-11965.9	-10248.1	-14728.9

0.98642   25011.1   15780.2   1.406.5   1.406.5   1.106.5   1.106.5   1.40				1			
0.5643	0.369546	250519.3	152840.8	-14505.5	-11822.9	-10214.5	-14615.3
0.15571   1.00020   1.00	0.364347	252604.7	150842.2	-14265.5	-11467.1	-10128.9	-14331
0.1515/17   2509/02   1400/02   14340.5   1307/03   4981.9   14160.5   1307/03   1401.5   1307/03   1401.5   1307/03   1401.5   1307/03   1401.5   1307/03   1401.5   1307/03   1401.5   1307/03   1401.5   1307/03   1401.5   1307/03   1401.5   1307/03   1401.5   1	0.36431	252619.5	150828		-11464.6		-14329
0.486628			+				
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0.39947   200007.2   141224.6   13100.1   59900.1   59900.1   59900.2   1.12224.6   1.1100.1   59700.1   59800.1   59900.1   1.12224.6   1.1100.1   59700.1   59900.							
0.3991   2000.72   1402.84   13100.4   3790.1   3498.86   1.2990.1	0.344546	260550.6	143234.5			-9784.57	-13246.4
0.328771   26969.37   13779.33   1-2297.7   5915.08   5497.23   1-2390   0.328771   26969.37   13779.33   1-2297.7   5915.08   5497.23   1-2390   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   0.3216.2	0.339347	262637.3	141238.6	-13102.1	-9800.61	-9689.64	-12961.1
0.328771   26969.37   13779.33   1-2297.7   5915.08   5497.23   1-2390   0.328771   26969.37   13779.33   1-2297.7   5915.08   5497.23   1-2390   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   12090   0.3216.23   0.3216.2	0.33931	262652.2	141224.4	-13100.4	-9798.21	-9688.96	-12959.1
0.238271 20696037 1372633 1-125767 9495.58 9-487.33 1-12566 0.125272 207974.2 114488 1-12271.8 8086.3 80 955.23 1 1-1266 0.12564 170584.5 1-12271.8 8086.3 80 955.23 1 1-1266 0.12564 170584.5 1-12271.8 4855.06 955.06 14 1-12271.8 1-12271.8 4855.06 955.06 14 1-12271.8			+				
0.31623 2907542 134548 132718 3 6315.06 9312.04 13196.12 1316.13 142713 8631.06 9312.04 13196.12 0 1316.13 142713 8631.06 9312.04 13196.12 0 1316.13 142713 8631.06 9312.04 13196.12 0 1316.13 142713 8631.06 9312.04 13196.12 0 1316.13 142713 8631.06 9312.04 13196.12 0 1316.13 142713							
0.319585   2708888   313841.3   31214.3   8833.00   -9312.01   31872.2   0.31447   27276.7   111642   11903.3   807.05   -930.88   11585.2   0.31511   27008   127085   112641   11908.5   8805.66   -9203.4   11836.6   0.00511   27008   127088   127343   112642   7944.1   10808.6   -9203.4   11836.6   0.00511   27008   127088   127343   112642   7944.1   10808.6   -9203.4   11836.6   0.00511   27008   127343   12709.1   11000.2   -9785.5   -9809.8   -10001.4   0.28947   282728   12207.7   1074.3   -6885.3   -8809.8   -10001.4   0.28948   222778   12207.7   1074.3   -6885.3   -8809.8   -10001.4   0.28948   222778   12207.7   1074.3   -6885.3   -8809.8   -10001.4   0.28949   222778   12207.8   -10207.7   -1074.3   -6885.3   -8809.8   -10001.4   0.27951   208987   11791.1   -9244.7   -8845.2   -8805.2   -905.1   0.27952   208987   11791.1   -9244.7   -8845.2   -8805.2   -9785.2   0.26967   22776.4   -11570.1   -9244.7   -8845.2   -8805.2   -9785.2   0.26967   22776.4   -11570.1   -9244.7   -8845.2   -8805.2   -9785.2   0.26967   22776.4   -11570.1   -9244.7   -8845.2   -8805.2   -9785.2   0.26967   22776.4   -11570.1   -9244.7   -8805.2   -9785.2   -9785.2   0.26967   22776.4   -9785.2   -9785.2   -9785.2   -9785.2   0.26967   22776.4   -9785.2   -9785.2   -9785.2   -9785.2   -9785.2   0.26967   22776.4   -9785.2   -978			+				
0.31437   272876 7   313682   31390.3   4307.95   -2008.8   -11586.7   0.31431   27286 1   31168.1   11398.3   800.66   -4201.1   -11586.7   0.32571   277056   127518   11024.1   17024.1   -7741.1   -4809.9   -1090.8   0.29521   279984   12857.4   -1107.7   -7721.2   -4868.2   -1005.2   0.29521   279984   12857.4   -1107.7   -7721.2   -4868.2   -1005.2   0.29531   2727.2   12857.4   -1107.7   -7721.2   -4868.2   -1005.2   0.29531   2727.2   12707.3   -1107.5   -4868.3   -4860.0   -1007.3   0.29531   2727.2   2707.5   -1007.4   -4868.3   -4860.0   -1007.4   0.29531   2727.2   28705.3   11768.5   -1029.3   -6055.7   -4865.7   -4865.7   -4865.7   -4865.7   0.29532   28898.7   113221.1   -9244.2   -5954.2   -4852.2   -4852.2   -4852.2   0.2964.6   -2966.5   -11526.4   -4852.4   -4852.2   -4852.2   -4852.2   0.2964.7   -2077.4   -11506.4   -4865.3   -4865.7   -4865.7   -4865.7   -4865.7   0.2964.7   -2077.4   -11506.4   -4865.4   -4865.7   -4865.7   -4865.7   -4865.7   0.2964.7   -2077.4   -11506.4   -4865.4   -4865.7   -4865.7   -4865.7   0.2964.7   -2077.4   -11506.4   -4865.4   -4865.7   -4865.7   -4865.7   0.2964.7   -2077.4   -11506.4   -4865.4   -4865.7   -4865.7   -4865.7   0.2964.7   -2077.4   -11506.4   -4865.4   -4865.7   -4865.7   -4865.7   0.2964.7   -2077.4   -11506.4   -4865.4   -4865.7   -4865.7   -4865.7   0.2964.7   -2077.4   -11506.4   -4865.4   -4865.7   -4865.7   -4865.7   0.2964.7   -2077.4   -2077.4   -11506.4   -4865.4   -4865.7   -4866.2   -48	0.321623	269754.2	134438		-8663.86		
0.31431   2779015   3130141   -11285   -8205.66   -9205.16   -1189808   0.000777   277006   127518   -112014   -7744.16   -8888.56   -109061   -110002   -69063   -8401.55   -100064   -110002   -69063   -8401.55   -100064   -110002   -69063   -8401.55   -100064   -110002   -69063   -8401.55   -100064   -110002   -69063   -8401.55   -100064   -110002   -69063   -8401.55   -100064   -110002   -69063   -8401.55   -100064   -110002   -69063   -8401.55   -100064   -	0.319545	270588.6	133641.3	-12174.3	-8533.06	-9312.04	-11872.2
0.31431   2729015	0.314347	272676.7	131648.2	-11930.3	-8207.95	-9208.88	-11585.7
0.393571 277066 127518 3 1124517 774232 8880.25 1.056532 0.236523 277045 128573	0.31431		+				
0.298673							
0.289545   280633   1240619   110002   49985   4801.45   1.1091.4   0.289347   22272.3   1.2071.8   1.1075.4   4.686.5   4.8960.81   1.0073.4   0.28931   22272.8   1.22071.8   1.1075.3   4.686.5   4.8960.81   1.0073.4   0.27671   22086.7   1.1075.3   4.686.5   4.8960.02   1.0073.4   0.2767.1   2.2086.7   1.1075.1   1.1075.3   4.686.5   4.8960.02   1.0073.4   0.2762.3   2.2086.7   1.1075.1   1.1075.1   2.2086.7   2.2086.7   1.1075.1   2.2086.7   2.2086.7   2.2086.7   1.1075.1   2.2086.7							
0.289347   287729   1120718   1-10756   -6688.51   -8690.01   -102013   -0.28931   227737.8   112067.7   -10754.3   -6686.34   -8.680.00   -102013   -0.278571   22705.5   -102705.3   -10250.3   -6057.4   -8456.75   -9605.7   -0.2765.3   -0.2765.3   -111791.1   -9294.2   -9505.62   -8505.2   -9218.45   -0.2695.6   -20885.3   -11409.9   -927.65   -9557.5   -9557.6   -8555.7   -9557.2							
0.28831	0.294545	280633.3	124061.9	-11000.2	-6998.53	-8801.45	-10491.4
0.278571 28705.3 11794L5 -1.0250.3 -0.055.74 8486.77 9605.1 0.27623 28989.9 11529L1 9924.42 9-656.62 8805.5 925.5 9218.45 0.2605.66 29068.3 11460.9 9827.05 1-555.7 4 8255.91 9.1027.1 0.26437 292776.4 112509.8 9585.2 1 9.1027.1 0.26437 292776.4 112509.8 9585.2 1 9.1027.1 0.26431 292771.1 11269.7 9581.81 1-5238.2 8137.45 9801.2 1 9.202.1 0.26431 292771.1 11269.7 9581.81 1-5238.2 8137.45 9801.2 1 9.202.1 0.26431 292771.1 11269.7 9581.81 1-5238.2 1837.45 9801.2 1 9.202.1 1 9.	0.289347	282722.9	122071.8	-10756	-6688.53	-8690.81	-10203.4
0.278571 28705.3 11794L5 -1.0250.3 -0.055.74 8486.77 9605.1 0.27623 28989.9 11529L1 9924.42 9-656.62 8805.5 925.5 9218.45 0.2605.66 29068.3 11460.9 9827.05 1-555.7 4 8255.91 9.1027.1 0.26437 292776.4 112509.8 9585.2 1 9.1027.1 0.26437 292776.4 112509.8 9585.2 1 9.1027.1 0.26431 292771.1 11269.7 9581.81 1-5238.2 8137.45 9801.2 1 9.202.1 0.26431 292771.1 11269.7 9581.81 1-5238.2 8137.45 9801.2 1 9.202.1 0.26431 292771.1 11269.7 9581.81 1-5238.2 1837.45 9801.2 1 9.202.1 1 9.	0.28931	282737.8	+	-10754 3			-10201 3
0.271623   288847   115291.1   .9924.42   .5554.62   .8302.52   .9218.45     0.29566   200885.3   11409.9   .9827.05   .5555.74   .8255.91   .9027.1     0.264347   .922776.4   .112508.8   .9581.4   .520.34   .818.37   .8812.81     0.24531   .292791.2   .112695.7   .9581.8   .5238.25   .817.45   .8810.75     0.25527   .29711.2   .10839.3   .9079.4   .4677.4   .780.0.0   .8210.53     0.246528   .30074.8   .1096.9   .4754.8   .4752.2   .7767.77   .770.45     0.245549   .30074.8   .1096.9   .4817.8   .4411.3   .7677.31   .7704.5     0.245549   .30074.8   .1096.9   .4817.8   .4411.5   .7677.31   .7704.5     0.23871   .30077.7   .9885.3   .4709.9   .4411.5   .3767.3   .7707.2   .7704.5     0.22871   .30077.7   .9885.3   .7913.6   .3285.2   .7913.3   .6805.5     0.23871   .30077.7   .9885.3   .7913.6   .3285.2   .7913.3   .6805.5     0.21823   .30097.5   .9800.7   .790.3   .4700.6   .291.8   .7707.7   .7704.5     0.21823   .30097.5   .9800.7   .790.3   .790.5   .790.5   .790.5     0.21834   .312821.8   .9443.3   .7725.8   .224.9   .7913.7   .690.5     0.21431   .312921.8   .9443.7   .7751.00   .2543.2   .993.7   .990.8     0.070571   .31724.7   .8930.3   .675.5   .675.5   .990.6   .4606.5   .497.5     0.18623   .2005.8   .3008.8   .8866.2   .6606.2   .4606.8   .497.2   .790.5     0.18931   .2000   .8986.23   .6043.2   .440.0   .6406.8   .497.2   .790.3     0.18931   .2000   .8986.23   .6043.3   .419.2   .440.0   .6406.8   .497.2   .790.5     0.18931   .2000   .8996.23   .6043.3   .419.2   .440.0   .6406.8   .497.2   .495.7   .795.6   .795.			+				
D.   1969-16   290883   11496-9   9827.05   .5557.4   .8255.9   .910.71			+				
0.264447   292776.4   112509.8   -9583.54   -520.34   -5118.79   -5812.61   0.24513   227912   112895.7   -9581.81   -5228.25   -58117.45   -580.02   -8210.53   0.266623   299908.6   105739.9   -8754.81   -4755.2   -7726.77   -7721.71   0.2455.6   -30074.8   10046.9   -8667.34   -4161.92   -7677.49   -7704.55   -7677.40   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -7677.49   -7704.55   -770			+				
0.26431   2927912   112897,   6951.81   -228.25   8137.45   8810.75     0.235971   297112   10883   9.679.4   4.657.4   7.780.02   420.03     0.246623   29988.6   10573.9   8754.81   4.755.2   7726.77   7.782.113     0.24546   30074.8   10948.9   867.74   4.141.92   7.767.49   7.704.55     0.239347   300337.6   10561.1   8415.77   3800.43   7.553.21   7.412.49     0.29931   300352.4   10999   8415.65   3888.85   7.752.33   7.410.42     0.228571   30776.7   9885.27   7.7913.56   4.288.82   7.791.3   4.805.51     0.21623   30975.5   96204.72   7.790.54   7.291.89   7.791.3   4.805.51     0.21623   30975.5   96204.72   7.790.54   7.291.8   7.791.3   4.805.51     0.21623   30975.5   96204.72   7.790.54   7.791.8   7.79	0.269546	290685.3	114496.9	-9827.05	-5535.74	-8255.91	-9102.71
0.24631   2927912   112895.7   5958.81   -528.825   8137.45   8810.75	0.264347	292776.4	112509.8	-9583.54	-5240.34	-8138.29	-8812.81
Q.253571   297112   108393   9079-A   4-637A   7-780.02   4-210.53							
0.246623   299988 6   105739.9   .8754.81   .425.2   .7726.77   .7721.13			<b>-</b>				
C.244546   3007448   104946.9   3657.84   4:141.92   7:677.49   7:7704.55							
0.239347 302837.6 10295.3 1 8415.37 -3860.43 .7553.21 -7412.02 0.23931 302852.4 102959 8413.65 -3858.82 .7553.33 .7410.02 10.228571 307176.7 98853.27 .7913.56 -3285.82 .7291.3 4-6805.51 0.2126.23 309075.5 9620.072 .7590.54 .2291.49 .7119.34 .4612.91 0.2195.46 310812.4 95413.13 .7494.06 .2813.5 .7067.46 .4295.35 0.214347 31200.6 .9342.281 .7752.8 .2565.1 .4595.71 .4500.077 0.21431 312921.8 95418.77 .7251.09 .2543.21 .6955.78 .5998.68 0.20357.1 317245.7 8933.043 .4575.2 1.199.00 .2543.21 .6955.78 .5998.68 0.20357.1 317245.7 8933.043 .4575.2 1.199.00 .2543.21 .6955.78 .5998.68 0.20357.1 317245.7 8933.043 .4575.2 1.199.00 .2661.42 .5388.31 0.1966.23 320051.1 86686.83 .6432.12 .1649.36 .6480.85 .4992.0 1.0196.59 .320081.7 8200.00 .8506.2 .4506.00 .1790.00 .6282.4 .4575.78 0.18947 .12289.1 83920.24 .6096.03 .1290.03 .6282.2 .4557.87 0.18947 .12289.1 83920.24 .6096.03 .1290.03 .6282.2 .4557.67 0.178571 .327332 .75825.99 .5599.06 .766.459 .6000.5 .3556.0 0.1716.2 .33001.5 .7187.84 .5279.00 .4540.06 .511.2 .355.00 .5956.0 .500.0 .1016.2 .330074.5 .7659.2 .4571.67 .500.0 .1016.2 .330074.5 .7659.2 .4571.67 .4500.0 .5100.0 .5754.16 .330074.5 .7500.0 .1016.2 .330074.5 .7659.2 .4500.0 .4500.0 .500.0 .5754.16 .330074.5 .7500.0 .1016.2 .330074.5 .7659.0 .4500.0 .4500.0 .5754.16 .330074.5 .7500.0 .1016.2 .330074.5 .7659.0 .4500.0 .4500.0 .5754.16 .330074.5 .7500.0 .1016.2 .330074.5 .7659.0 .4500.0 .4500.0 .4500.0 .5754.16 .330074.5 .7500.0 .4500.0			+				
0.228371 3020852.4 102949 8413.65 3858.65 7.752.33 7.7410.02 0.228571 307176.7 9885.377 7.983.56 3-285.8.65 7.729.13 6.8605.51 0.221622 300995.5 96204.72 7.7590.54 -2921.49 7.719.34 6.412.01 0.219546 310812.4 9.5413.13 7.7494.06 1.2813.5 7.067.46 6.595.35 0.214347 312906.9 93421.81 7.725.8 2.545.1 6.936.71 6.900.77 0.21431 312921.8 93418.77 7.7251.09 2.545.1 1.995.07.8 6.9598.68 0.203571 317249.7 89330.43 6.7573.52 1.1997.02 6.661.42 5.388.31 0.196623 32005.1 86666.83 6.4632.12 1.669.3 6.4680.85 4.4992 0.189454 32008.87 85896.74 6.333.11 1.1546.28 6.426.4 4.873.29 0.18947 322985.1 83820.24 6.096.33 1.1290.3 6.289.2 4.4573.67 0.178571 327322 7932.59 6.590.60 7.766.49 6.000.5 3-3956.96 0.1766.3 33007.5 7.7197.94 5.279.03 4.340.96 5.581.23 3.359.69 0.169546 330074.5 76399.41 5.188.41 3.355.07 5.754.16 3.346.26 0.164347 333073.1 77427.11 4.944.25 9.03.424 5.610.4 3.33387.3 37424.4 70341.91 4.448.93 411.0298 5.307.93 7.33324.4 5.016.23 3.301.24 7034.19 4.448.93 411.0298 5.307.93 7.33324.4 7034.19 1.448.93 411.0298 5.307.93 7.33324.4 7034.19 1.448.93 411.0298 5.307.93 7.33324.4 70341.91 6.448.93 441.0298 5.307.93 7.33324 6.016.23 34021.5 6.000.5 3.3966.2 6.016.23 34021.5 6.000.5 3.3966.2 6.004.33 8.247.18 1.509.37 7.3133.2 6.015357.1 337424.4 70341.91 4.448.93 411.0298 5.307.93 7.3332.4 6.016.23 34021.5 6.000.5 7.3566.4 6.000.5 7.506.4 7.506.	0.244546	300744.8	104946.9	-8657.84	-4141.92	-7677.49	-7704.55
0.228371 3020852.4 102949 8413.65 3858.65 7.752.33 7.7410.02 0.228571 307176.7 9885.377 7.983.56 3-285.8.65 7.729.13 6.8605.51 0.221622 300995.5 96204.72 7.7590.54 -2921.49 7.719.34 6.412.01 0.219546 310812.4 9.5413.13 7.7494.06 1.2813.5 7.067.46 6.595.35 0.214347 312906.9 93421.81 7.725.8 2.545.1 6.936.71 6.900.77 0.21431 312921.8 93418.77 7.7251.09 2.545.1 1.995.07.8 6.9598.68 0.203571 317249.7 89330.43 6.7573.52 1.1997.02 6.661.42 5.388.31 0.196623 32005.1 86666.83 6.4632.12 1.669.3 6.4680.85 4.4992 0.189454 32008.87 85896.74 6.333.11 1.1546.28 6.426.4 4.873.29 0.18947 322985.1 83820.24 6.096.33 1.1290.3 6.289.2 4.4573.67 0.178571 327322 7932.59 6.590.60 7.766.49 6.000.5 3-3956.96 0.1766.3 33007.5 7.7197.94 5.279.03 4.340.96 5.581.23 3.359.69 0.169546 330074.5 76399.41 5.188.41 3.355.07 5.754.16 3.346.26 0.164347 333073.1 77427.11 4.944.25 9.03.424 5.610.4 3.33387.3 37424.4 70341.91 4.448.93 411.0298 5.307.93 7.33324.4 5.016.23 3.301.24 7034.19 4.448.93 411.0298 5.307.93 7.33324.4 7034.19 1.448.93 411.0298 5.307.93 7.33324.4 7034.19 1.448.93 411.0298 5.307.93 7.33324.4 70341.91 6.448.93 441.0298 5.307.93 7.33324 6.016.23 34021.5 6.000.5 3.3966.2 6.016.23 34021.5 6.000.5 3.3966.2 6.004.33 8.247.18 1.509.37 7.3133.2 6.015357.1 337424.4 70341.91 4.448.93 411.0298 5.307.93 7.3332.4 6.016.23 34021.5 6.000.5 7.3566.4 6.000.5 7.506.4 7.506.	0.239347	302837.6	102963.1	-8415.37	-3860.43	-7553.21	-7412.49
0.28571   307176.7   98853.27   7933.56   -3285.82   7.793.34   -6805.51							
0.21623   309975.5   96,004.72   7.799.0.54   -2921.49   -7119.34   -6412.91							
0.219546 310812.4 95413.13 7.494.06 2.2813.5 7.067.46 6.525.35 0.21431 31291.8 93418.77 7.7551.09 7.2551.1 6.935.78 5.998.68 0.203571 317249.7 89330.43 6.7573.52 1.997.02 6.666.142 5.388.31 0.1952.3 1200.1571 317249.7 89330.43 6.7573.52 1.997.02 6.666.142 5.388.31 0.1952.3 1200.1571 317249.7 89330.43 6.7573.52 1.997.02 6.666.142 5.388.31 0.1952.3 1200.1571 317249.7 89330.43 6.7573.52 1.997.02 6.666.142 6.358.3 1.01952.3 1200.1571 317249.7 89330.43 6.7573.52 1.997.02 6.666.142 6.358.3 1.01952							
0.214347   312906 9   39432.81   -7252.8   -2246.1   -6935.78   -6000.77     0.21431   312921.8   93418.77   -7251.09   -564.32   -6935.78   -5998.68     0.203571   31749.7   89330.43   -6753.52   -1997.02   -6661.42   -5388.31     0.196623   320051.1   86868.83   -6432.12   -1690.36   -6480.85   -4992.2     0.194545   32088.7   8320.24   -6336.11   -1546.28   -6426.4   -4872.29     0.18931   322000   88906.23   -6094.33   -1288.23   -6282.2   -4575.67     0.18931   322000   88906.23   -6094.33   -1288.23   -6282.2   -4575.67     0.18931   322300   88906.23   -6094.33   -1288.23   -6282.2   -4575.67     0.176571   327332   7982.59   -5599.06   -766.459   -6000.5   -3959.66     0.017623   330136   77187.84   -5279.03   -444.096   -5811.23   -3355.3     0.166546   330974.5   7679941   -5183.41   -335.507   -574.16   -3485.6     0.164347   333073.1   74472.11   -4944.25   -90.342.4   -5509.4   -3133.2     0.16431   333087.9   7441.11   -4944.25   -89.342.4   -5509.4   -3133.2     0.15653   34021.5   -5779.84   -4129.7   7296.68   -509.95   -509.95     0.14663   34021.5   -5779.84   -4129.7   7296.68   -509.95   -509.95     0.14656   54077   -5662.28   -4034.33   -6426.21   -569.97   -3133.2     0.158571   337424.4   77041.91   -4444.99   -4110.298   -590.95     0.14656   54077   -5662.28   -4034.33   -624.218   -509.95   -509.95     0.14656   34071.5   -5662.28   -4034.33   -624.218   -509.95   -509.95     0.14656   34071.5   -5662.28   -4034.37   -4034.33   -624.218   -509.95   -509.95     0.14656   34071.5   -5662.28   -4034.39   -4034.33   -603.28   -4034.39   -4034.33   -560.97   -4034.34   -509.95   -509.95     0.14656   35175.5   -509.95   -50	0.221623	309975.5	96204.72		-2921.49	-7119.34	-6412.91
0.21431 312921.8 93418.77	0.219546	310812.4	95413.13	-7494.06	-2813.5	-7067.46	-6295.35
0.21431 312921.8 93418.77	0.214347	312906.9	93432.81	-7252.8	-2545.1	-6936.71	-6000.77
0.203571   3172497   89330.43   -6753.52   1.997.02   -6661.42   5.388.31     0.196523   3200511   8668.68   3.6431.21   1.1640.36   -6480.85   4.992.2     0.194545   320888.7   85996.74   -6.336.11   1.1546.28   -6456.4   -4872.29     0.189347   322885.1   8390.24   -6096.03   1.1280.03   -6289.2   -4575.67     0.18931   323000   83906.23   -6094.33   -1.288.23   -6288.22   -4573.67     0.178571   32738.2   79825.99   -5599.06   -766.459   -6000.5   -3355.96     0.171623   330156   77187.84   -5279.03   -4340.69   -5811.23   -3556.3     0.169546   33074.5   76399.41   -5183.41   -335.507   -575.16   -3436.26     0.164347   333073.1   74427.11   -4944.25   -99.3424   -5610.4   -3133.3     0.16431   333087.9   74413.13   -4942.55   -486.121   -5609.37   -3133.2     0.153371   337424.4   70341.91   -4484.93   411.098   -5307.93   -2500.6     0.146623   340231.5   67799.84   -4129.74   729.6481   -5109.64   -2103.28     0.149347   34317.9   -6495.73   -3795.62   1099.15   -4899.21   -1676.7     0.139347   34317.9   -6495.73   -3795.62   1099.15   -4899.21   -1676.7     0.139347   34317.9   -6495.73   -3795.62   1099.15   -4899.21   -1676.7     0.12621   330339   5285.57   -2981.57   1848.002   -4374.26   -629.64     0.119466   351179.5   5747.34   -2886.1   1393.11   -4311.55   -506.156     0.119467   351828.2   -5509.3   -2647.07   -2165.97   -4153.48   -196.37     0.105771   35764.5   -5446.47   -2150.93   -228.26   -301.87   -301.98     0.009547   33528.1   5599.3   -2646.07   -2165.97   -4153.48   -196.37     0.009547   33528.1   5599.3   -2646.07   -2165.97   -4153.48   -196.37     0.009547   335328.1   5599.3   -2646.07   -2165.97   -4153.48   -196.37     0.009547   335328.1   5599.3   -2646.07   -2265.88   -2265.3   -226							
0.196523 3200511 86686.83 -6432.12 -1549.36 -5480.85 -4992.2   0.194545 32088.7 85896.74 -6336.11 1:546.28   -6426.4   -6487.29   0.189347 32285.1 83320.24 -6096.03 1:129.03   -6289.2   -4575.78   0.189347 32285.1 83320.24 -6096.03 1:129.03   -6289.2   -4575.78   0.178571 32733.2 998.25.9   -5599.0   -766.459   -600.5   -3956.66   0.171623 30136   -7787.84   -5279.03   -4484.06   -5811.23   -355.66   0.169546 330974.5   -76399.41   -5182.41   -335.507   -5754.16   -3486.26   -0.164347 333073.1   -74427.11   -4944.25   -90.3424   -5510.4   -5510.4   -3135.33   -0.16431 333087.9   -7413.13   -4942.55   -86.6121   -5093.7   -3133.2   -0.153571   33742.4   -7034.19   -4488.93   -4412.74   -729.48   -6488.8   -6489.8   -6							
0.194545			+				
0.189347 322985.1 83920.24 -6096.03 -1290.03 -6289.2 4-4575.78 0.189347 327332 79825.99 -5599.06 -766.459 -6000.5 -3956.65 0.171623 330136 77187.84 -5279.03 -434.096 -5811.23 -458.25 0.1059346 330974.5 76399.41 -5834.41 -353.507 -5754.16 -3485.26 0.106347 333073.1 74427.11 -4984.25 -90.3424 -5610.4 -3135.33 0.106347 333073.1 74427.11 -4984.25 -90.3424 -5610.4 -3135.33 0.106341 333087.9 74413.13 -4942.55 -88.6121 -5609.37 -3133.2 0.153571 33742.44 7734.191 -4448.93 411.0298 -5307.93 -2590.05 0.146623 340231.5 67709.84 -4129.74 729.681 -5109.64 -22193.28 0.148466 341071 66923.28 -4034.33 824.2181 -5009.85 -1981.66 0.139347 34317.9 64955.73 -3795.62 1059.515 -4899.21 -1676.7 0.13931 343186.8 64941.79 -3793.93 1061.177 -4898.14 -1676.53 0.12623 350339 58255.75 -2981.57 1848.002 -4374.26 -629.664 0.119346 351179.5 57471.34 -2886.1 1939.11 -4311.55 -560.166 0.114447 353283.2 55503.3 -2647.07 2165.97 -4153.46 -136.317 0.104447 353283.2 55503.3 -2647.07 2165.97 -4153.46 -136.317 0.105371 3475284 -6898.08 3300.79 -69.61.25 -70.61			+				
0.18931   323000   83906.23   -6094.33   -1288.23   -6288.22   -4573.67     0.178571   327332   79825.99   5599.06   -766.459   -6000.5   -3956.96     0.171623   330136   77187.84   -5279.03   -434.096   -5811.23   -4556.3     0.169546   330974.5   76399.41   -5183.41   -335.507   -5754.16   -3450.5     0.164347   333073.1   74427.11   -4944.25   -90.3424   -5610.4   -3135.33     0.16431   333087.9   74413.13   -4942.55   -486.6121   -5609.37   -3133.2     0.153571   33742.4   70341.91   -4448.93   -4448.93   -4410.99   -5307.93   -2509.05     0.146523   340231.5   -6709.84   -4129.74   729.6481   -5109.64   -2103.28     0.144546   -341071   -66923.28   -4034.33   -4042.55   -488.6121   -509.95   -1981.66     0.139347   -34317.9   -6955.73   -3795.62   -1059.515   -4899.21   -1076.7     0.13931   -343186.8   -6494.79   -3793.93   -1061.177   -4898.14   -1674.53     0.128571   -347528.4   -60880.83   -3300.79   -1541.325   -4582.2   -1041.54     0.119546   -35117.5   -55495.4   -2645.38   -2645.38   -2645.38   -2645.38   -2645.38   -2645.38   -2645.38   -2645.38   -265.97   -4153.48   -196.317     0.114347   -353283.2   -5509.3   -2647.07   -2165.97   -4153.48   -196.317     0.114347   -353283.2   -5509.3   -2647.07   -2165.97   -4153.48   -196.317     0.114347   -353283.2   -5509.3   -2647.07   -2165.97   -4153.48   -196.317     0.103571   -35764.7   -5346.47   -2150.93   -2631.81   -3820.53   -4494.60     0.09947   -3630.92   -4002.49   -1493.8   -328.82   -3509.4   -331.81   -3820.53   -494.47     0.09947   -3630.92   -4002.49   -1493.8   -328.82   -3509.4   -331.81   -3820.53   -494.47     0.09947   -3630.92   -4002.49   -1493.8   -328.82   -3509.4   -331.81   -3820.53   -364.42   -40078.63   -40078.	0.194545	320888.7	85896.74	-6336.11	-1546.28	-6426.4	-4873.29
0.18931   323000   83906.23   -6094.33   -1288.23   -6288.22   -4573.67     0.178571   327332   79825.99   5599.06   -766.459   -6000.5   -3956.96     0.171623   330136   77187.84   -5279.03   -434.096   -5811.23   -4556.3     0.169546   330974.5   76399.41   -5183.41   -335.507   -5754.16   -3450.5     0.164347   333073.1   74427.11   -4944.25   -90.3424   -5610.4   -3135.33     0.16431   333087.9   74413.13   -4942.55   -486.6121   -5609.37   -3133.2     0.153571   33742.4   70341.91   -4448.93   -4448.93   -4410.99   -5307.93   -2509.05     0.146523   340231.5   -6709.84   -4129.74   729.6481   -5109.64   -2103.28     0.144546   -341071   -66923.28   -4034.33   -4042.55   -488.6121   -509.95   -1981.66     0.139347   -34317.9   -6955.73   -3795.62   -1059.515   -4899.21   -1076.7     0.13931   -343186.8   -6494.79   -3793.93   -1061.177   -4898.14   -1674.53     0.128571   -347528.4   -60880.83   -3300.79   -1541.325   -4582.2   -1041.54     0.119546   -35117.5   -55495.4   -2645.38   -2645.38   -2645.38   -2645.38   -2645.38   -2645.38   -2645.38   -2645.38   -265.97   -4153.48   -196.317     0.114347   -353283.2   -5509.3   -2647.07   -2165.97   -4153.48   -196.317     0.114347   -353283.2   -5509.3   -2647.07   -2165.97   -4153.48   -196.317     0.114347   -353283.2   -5509.3   -2647.07   -2165.97   -4153.48   -196.317     0.103571   -35764.7   -5346.47   -2150.93   -2631.81   -3820.53   -4494.60     0.09947   -3630.92   -4002.49   -1493.8   -328.82   -3509.4   -331.81   -3820.53   -494.47     0.09947   -3630.92   -4002.49   -1493.8   -328.82   -3509.4   -331.81   -3820.53   -494.47     0.09947   -3630.92   -4002.49   -1493.8   -328.82   -3509.4   -331.81   -3820.53   -364.42   -40078.63   -40078.	0.189347	322985.1	83920.24	-6096.03	-1290.03	-6289.2	-4575.78
0.178571   32732   79825.99   -5599.06   -766.459   -600.05   -3956.96     0.171623   330136   77187.94   -5277.03   -4434.096   -5811.23   -3556.3     0.169546   33.0974.5   7639.941   -5183.41   -335.507   -574.16   -3436.26     0.164347   333073.1   74427.11   -4944.25   -9.04424   -5610.4   -3135.33     0.16431   333087.9   74413.13   -4942.55   -88.6121   -5609.37   -3133.2     0.153571   337424.4   7034.191   -4448.93   411.0298   -5307.93   -2509.05     0.166623   34023.15   67709.84   -4127.74   729.6481   -5109.64   -2103.28     0.144546   341071   66923.28   -4034.33   824.2181   -5109.85   -1981.66     0.139347   34317.9   64955.73   -3795.62   1059.515   -4899.21   -1676.7     0.13931   343186.8   6494.79   -3793.93   106.1177   -4898.14   -1674.53     0.12623   3503.9   5225.75   -2881.57   1848.002   -4374.26   -629.664     0.119546   351179.5   57471.34   -2886.1   1939.11   -4311.55   -506.156     0.11447   35328.2   55509.3   -2647.07   2165.97   -4153.48   -156.317     0.11431   353298.1   55495.4   -2645.38   2165.73   -4152.35   -194.117     0.103571   337645.7   51446.47   -2159.93   -228.26   -3301.87   -360.05   -					-1288 23		
0.1716/3   330136   77187.84   5-5279.03   4-34.096   5-581123   -3556.3			<b>-</b>				
0.169546   330974.5   76399.41   -5183.41   -335.507   -575.16   -3436.26   0.164347   333073.1   74427.11   -4944.25   -90.3424   -5610.4   -3135.33   0.16431   333087.9   74415.13   -4942.55   -88.6121   -5609.37   -3133.2   0.153571   33742.44   70341.91   -4448.93   -411.0298   -5307.93   -2509.05   -							
0.164347   333073.1   74427.11   4-944.25   -90.3424   -5610.4   -3135.33     0.16431   333087.9   74413.13   -4942.55   -88.6121   -5609.37   -3133.2     0.153571   337424.4   70341.91   -4448.93   411.0298   -5307.93   -2509.05     0.146623   340231.5   67709.84   -4129.74   729.6481   -5109.64   -2103.28     0.146524   341071   -66923.28   -4034.33   824.2181   -509.85   -1981.66     0.139347   343171.9   64955.73   -3795.62   1059.515   -4899.21   -1676.7     0.13931   343186.8   64941.79   -3793.93   1061.177   -4898.14   -1674.53     0.126571   347528.4   60880.83   -3300.79   1541.325   -4582.2   -1041.54     0.121623   350339   58255.75   -2981.57   1848.002   -4374.26   -629.664     0.119546   351179.5   57471.34   -2886.1   1939.11   -4311.55   -506.156     0.114347   353283.2   55509.3   -2647.07   2165.97   -4153.48   -196.317     0.103571   337645.7   5146.47   -2150.93   2631.381   -3380.53   -4452.2   -494.17     0.103571   337645.7   5146.47   -2150.93   2631.381   -3380.53   -4452.35   -494.17     0.103571   357645.7   5146.47   -2150.93   2631.381   -3380.53   -494.603     0.096623   360460.5   48829.71   -1833.31   -2928.326   -3601.87   869.0405     0.094545   36130.2   46078.63   -1492.0   3238.439   -3368.21   -3369.4   1310.811     0.08931   36342.2   46078.63   -1492.0   3238.439   -3368.21   1313.056     0.076571   367779.2   4204.47   -993.481   369.99   -3018.11   1970.441     0.07623   370599.2   39438.14   -669.257   3980.176   -2768.83   2399.557     0.0694347   373558.8   36698.92   -326.313   4284.366   -276.93   -276.83   -2399.57     0.0694347   373558.8   36698.92   -326.313   4284.366   -276.83   -2399.57     0.0694347   373558.8   36698.92   -326.313   4284.366   -276.33   -350.81     0.076523   370590.2   3948.54   -669.257   3980.176   -2768.83   -2399.57     0.0694347   373558.8   36698.92   -326.313   4284.366   -275.031   -2288.474     0.064347   373558.8   36698.92   -326.313   4284.366   -275.284   -4442.401     0.03931   383738.8   27385.64   866.0989   5320.596			+				
0.16431   3330879   74415.13   .4942.55   .88.6121   .5600.37   .3133.2     0.153571   33742.4   70341.91   .4448.93   .411.0298   .5307.93   .2509.05     0.146523   340231.5   .67709.84   .4129.74   .729.6481   .5109.64   .2103.28     0.144546   341071   .66932.28   .4034.33   .824.2181   .5049.85   .1981.66     0.139347   .343171.9   .64955.73   .3795.62   .1059.515   .4899.21   .1676.7     0.13931   .343186.8   .64941.79   .3799.93   .1061.177   .4898.14   .1674.53     0.128571   .347528.4   .6088.08.3   .3300.79   .1541.325   .4882.2   .1041.54     0.121623   .350339   .5825.75   .2981.57   .1848.002   .4374.26   .629.664     0.119546   .351179.5   .57471.34   .2886.1   .1939.11   .4311.55   .506.156     0.114347   .3528.32   .55509.3   .2647.07   .2165.97   .4153.48   .196.317     0.103571   .35764.5   .5464.67   .2150.93   .6513.381   .3820.51   .494.603     0.096623   .360460.5   .48829.71   .1830.31   .2928.326   .3601.87   .869.045     0.098347   .36309.2   .46072.49   .1433.8   .3236.882   .3369.4   .1310.811     0.098347   .36309.2   .46078.63   .1492.09   .3238.439   .336.21   .1313.081     0.089347   .36309.2   .46078.63   .1492.09   .3238.439   .3368.21   .1313.081     0.089347   .36309.2   .40078.63   .1492.09   .3238.439   .3368.21   .1313.056     0.076551   .3779.2   .42044.47   .993.481   .3699.99   .3018.11   .1970.441     0.071623   .370599.2   .3943.14   .669.257   .3800.176   .2786.83   .2399.557     0.069454   .37353.8   .3610.2   .3668.27   .3826.99   .3018.11   .1970.441     0.064347   .37355.8   .3669.59   .3268.27   .3830.176   .2786.83   .2399.557     0.06623   .3606.0   .3836.6   .3608.59   .3286.27   .3800.176   .2786.83   .2399.557     0.069545   .3714.2.6   .38659.57   .572.028   .4066.691   .2716.91   .228.474     0.064347   .37355.8   .3669.59   .3268.47   .318.386   .4729.66   .42716.91   .228.474     0.064347   .37355.8   .3666.9   .2766.9   .42716.91   .228.474     0.064347   .37355.8   .3666.9   .3266.9   .3666.9   .42716.9   .3366.9   .4286.9     0.03347   .33836.4   .33	0.169546	330974.5	76399.41	-5183.41	-335.507	-5754.16	-3436.26
0.153571   337424.4   70341.91   4448.93   411.0298   5307.93   2509.05	0.164347	333073.1	74427.11	-4944.25	-90.3424	-5610.4	-3135.33
0.153571   337424.4   70341.91   4448.93   411.0298   5307.93   2509.05			+				
0.146623         340231.5         67709.84         -4129.74         729.6481         -5109.64         -2103.28           0.144546         341071         66932.88         -4034.33         824.2181         -5049.85         -1981.66           0.139347         343171.9         64955.73         -3795.62         1059.515         -4889.21         -1676.7           0.13931         343186.8         64941.79         -3793.93         1061.177         -4898.14         -1676.53           0.128571         34752.84         60880.83         -330.79         1541.325         -4582.2         -1041.54           0.121623         350339         58255.75         -2981.57         1848.002         -4374.26         -629.664           0.119546         351179.5         57471.34         -2886.1         1939.11         -4315.5         -506.156           0.114347         352383.2         55509.3         -2647.07         2165.97         -4153.48         -196.117           0.014371         352383.1         55495.4         -2645.38         2167.573         -4152.35         -194.117           0.14347         352383.2         15509.3         -2647.07         2165.97         -4153.48         -196.017           0.013571         3564							
0.144546   341071   66923.28   4-034.33   824.2181   5-049.85   -1981.66							
0.139347   343171.9   64955.73   .3795.62   1059.515   .4899.21   .1676.7							
0.13931         343186.8         64941.79         -3793.93         1061.177         -4898.14         -1674.53           0.128571         347528.4         60880.83         -3300.79         1541.325         -4882.2         -1041.54           0.121623         350339         58255.75         -2981.57         1848.002         -4374.26         -629.664           0.119546         351179.5         57471.34         -2886.1         1939.11         -4311.55         -506.156           0.114347         353283.2         55509.3         -2647.07         2165.97         -4153.48         -196.317           0.01431         353298.1         55495.4         -2664.38         2167.573         -4152.35         -194.117           0.03571         357645.7         51446.47         -2150.93         2631.381         -3820.53         449.603           0.096523         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.005           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.078571         36	0.144546	341071	66923.28	-4034.33	824.2181	-5049.85	-1981.66
0.128571         347528.4         60880.83         -3300.79         1541.325         -4582.2         -1041.54           0.121623         350339         58255.75         -2981.57         1848.002         -4374.26         -629.664           0.119546         351179.5         57471.34         -2886.1         1939.11         -4311.55         -506.156           0.114347         35283.2         55509.3         -2647.07         2165.97         -4153.48         -196.317           0.11431         353283.1         55495.4         -2645.38         2167.573         -4152.35         -194.117           0.103571         357645.7         51446.47         -2150.93         2631.381         -380.03         449.603           0.096623         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.005           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.089347         363424.2         46078.63         -1492.09         3238.439         -3368.21         1313.056           0.078571         36	0.139347	343171.9	64955.73	-3795.62	1059.515	-4899.21	-1676.7
0.128571         347528.4         60880.83         -3300.79         1541.325         -4582.2         -1041.54           0.121623         350339         58255.75         -2981.57         1848.002         -4374.26         -629.664           0.119546         351179.5         57471.34         -2886.1         1939.11         -4311.55         -506.156           0.114347         35288.2         55509.3         -2647.07         2165.97         -4153.48         -196.317           0.11431         353288.1         55495.4         -2645.38         2167.573         -4152.35         -194.117           0.103571         357645.7         51446.47         -2150.93         2631.381         -3800.53         449.603           0.096623         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.005           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.089347         36349.2         46078.63         -1492.09         3238.439         -3368.21         1310.65           0.078571         36779.2         42044.47         -993.881         3689.99         -3018.11         1970.441           0.071623         37059	0.13931	343186.8	64941 79	-3793 93	1061 177	-4898 14	-1674 53
0.121623         350339         58255.75         -2981.57         1848.002         -4374.26         -629.664           0.119546         351179.5         57471.34         -2886.1         1939.11         -4311.55         -506.156           0.114347         353283.2         55509.3         -2647.07         2165.97         -4153.48         -196.317           0.11431         353283.2         55509.3         -2647.07         2165.97         -4153.48         -196.317           0.013571         357645.7         5146.64         -2150.93         2631.381         -3802.53         449.6403           0.09623         360460.5         48829.71         -1830.31         2928.326         -3601.87         8690.405           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.08931         365409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.078571         36779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069454         371			+				
0.119546         351179.5         57471.34         -2886.1         1939.11         -4311.55         -506.156           0.114347         353283.2         55509.3         -2647.07         2165.97         -4153.48         -196.317           0.11431         35328.1         55495.4         -2645.38         2167.573         -4152.35         -194.117           0.013571         357645.7         51446.47         -2150.93         2631.381         -3820.53         449.6403           0.096623         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.0405           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         2236.882         -3369.4         1310.811           0.078571         36779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.06437 <td< td=""><td></td><td></td><td>+</td><td></td><td></td><td></td><td></td></td<>			+				
0.114347         353283.2         55509.3         -2647.07         2165.97         -4153.48         -196.317           0.11431         353298.1         55495.4         -2645.38         2167.573         -4152.35         -194.117           0.103571         357645.7         51446.47         -2150.93         2631.381         -3820.53         449.603           0.09623         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.0405           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.08931         363424.2         46078.63         -1492.09         3238.439         -368.21         1313.056           0.078571         367779.2         4204.47         -993.481         3689.99         -3018.11         1970.441           0.076535         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.06934         373558.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         3							
0.11431         353298.1         55495.4         -2645.38         2167.573         -4152.35         -194.117           0.013571         357645.7         51446.47         -2150.93         2631.381         -3820.53         449.6403           0.096623         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.0405           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.078571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.06945         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.064341         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571	0.119546	351179.5	57471.34		1939.11	-4311.55	-506.156
0.11431         353298.1         55495.4         -2645.38         2167.573         -4152.35         -194.117           0.03571         357645.7         51446.47         -2150.93         2631.381         -3820.53         449.6403           0.096623         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.0405           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.08571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.06943         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         37556.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         <	0.114347	353283.2	55509.3	-2647.07	2165.97	-4153.48	-196.317
0.103571         357645.7         51446.47         -2150.93         2631.381         -3820.53         449.6403           0.096623         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.0405           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.08931         363424.2         46078.63         -1492.09         3238.439         -3368.21         1313.056           0.078571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.079545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.055571         37793.6         32684.27         181.3886         4729.66         -2166.23         355.581           0.046623	0.11431	353298 1	55495 4	-2645.38	2167.573	-4152.35	-194.117
0.096623         360460.5         48829.71         -1830.31         2928.326         -3601.87         869.0405           0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.08931         363424.2         46078.63         -1492.09         3238.439         -3368.21         1313.056           0.078571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         37793.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.044545			<b>-</b>				
0.094545         361302.2         48047.87         -1734.32         3016.662         -3535.87         994.8947           0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.08931         363424.2         46078.63         -1492.09         3238.439         -3368.21         1313.056           0.078571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.053571         377933.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.03931			+				
0.089347         363409.2         46092.49         -1493.8         3236.882         -3369.4         1310.811           0.08931         363424.2         46078.63         -1492.09         3238.439         -3368.21         1313.056           0.078571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.053571         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         377933.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.03931							
0.08931         363424.2         46078.63         -1492.09         3238.439         -3368.21         1313.056           0.078571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         37793.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931			+				
0.078571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         37793.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         38373.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623	0.089347	363409.2	46092.49	-1493.8	3236.882	-3369.4	1310.811
0.078571         367779.2         42044.47         -993.481         3689.99         -3018.11         1970.441           0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         37793.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         38373.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623	0.08931	363424.2	46078.63	-1492.09	3238.439	-3368.21	1313.056
0.071623         370599.2         39438.14         -669.257         3980.176         -2786.83         2399.557           0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         377933.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         38373.8         27369.94         866.0989         5321.905         -1653.21         4442.401           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.014347			<b>-</b>				
0.069545         371442.6         38659.57         -572.028         4066.691         -2716.91         2528.474           0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         377933.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931         383738.8         27369.94         866.0989         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.012623         399057.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.01437							
0.064347         373553.8         36712.71         -328.046         4282.795         -2540.31         2852.412           0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         377933.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931         383738.8         27369.94         866.0989         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347	<del></del>						
0.06431         373568.8         36698.92         -326.313         4284.326         -2539.05         2854.716           0.053571         377933.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931         383738.8         27369.94         866.089         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.513         -191.829         6894.479							
0.053571         377933.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931         383738.8         27369.94         866.0989         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.513         -191.829         6894.479	0.064347	373553.8	36712.71	-328.046	4282.795	-2540.31	2852.412
0.053571         377933.6         32684.27         181.3886         4729.66         -2166.23         3530.581           0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931         383738.8         27369.94         866.0989         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.513         -191.829         6894.479	0.06431	373568.8	36698.92	-326.313	4284.326	-2539.05	2854.716
0.046623         380760.7         30092.23         513.2232         5017.794         -1918.63         3973.358           0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931         383738.8         27369.94         866.0989         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.513         -191.829         6894.479           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479			+				
0.044545         381606.4         29318.25         613.0512         5104.056         -1843.52         4106.68           0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931         383738.8         27369.94         866.0989         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         688.513         -191.829         6894.479							
0.039347         383723.8         27383.64         864.3096         5320.369         -1653.21         4442.401           0.03931         383738.8         27369.94         866.0989         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479	<del></del>		+				
0.03931         383738.8         27369.94         866.0989         5321.905         -1651.84         4444.792           0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479			<b>-</b>				
0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479	0.039347	383723.8	27383.64	864.3096	5320.369	-1653.21	4442.401
0.028571         388118.5         23385.01         1393.343         5772.498         -1246.34         5149.461           0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479	0.03931	383738 8	27369.94	866.0989	5321.905	-1651.84	4444.792
0.021623         390957.5         20816.79         1742.471         6068.904         -973.057         5615.488           0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479			<b>-</b>				
0.019545         391807.2         20050.94         1848.484         6158.687         -889.275         5756.769           0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479							
0.014347         393936.2         18139.5         2118.068         6386.722         -674.438         6115.244           0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479							
0.01431         393951.3         18125.98         2120.005         6388.36         -672.884         6117.814           0.003571         398367.4         14213.87         2710.157         6888.513         -191.829         6894.479			+				
0.003571 398367.4 14213.87 2710.157 6888.513 -191.829 6894.479	0.014347	393936.2	18139.5	2118.068	6386.722	-674.438	6115.244
0.003571 398367.4 14213.87 2710.157 6888.513 -191.829 6894.479	0.01431	393951.3	18125.98	2120.005	6388.36	-672.884	6117.814
			<b>-</b>				
2.500-04 399740.4 13030.08 2918.055 7067.46 -16.6013 7160.844							

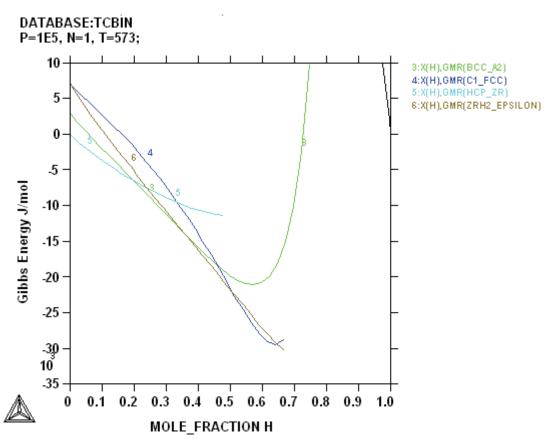


Figure A1 Thermodynamic properties of different phases at T=300°C

Table A2 Gibbs thermodynamic potentials of different phases in the Zr-H system at 350°C (in J/mole)

X(H)	GMR(GAS)	GMR(IONIC_LIQ)	GMR(BCC_A2)	GMR(C1_FCC)	GMR(HCP_ZR)	GMR(ZRH2_EPS)
0.99975	92.86265	399891.1	11864.89	-26248	-10024.1	-27958.6
0.994546	2069.708	397710.9	11864.89	-26248	-10024.1	-27958.6
0.969546	11692.54	387492.4	11864.89	-26248	-10024.1	-27958.6
0.944545	21378.83	377400.9	11864.89	-26248	-10024.1	-27958.6
0.919546	31097.11	367373.3	11864.89	-26248	-10024.1	-27958.6
0.894545	40837.6	357390.2	11864.89	-26248	-10024.1	-27958.6
0.869546	50595.4	347441.7	11864.89	-26248	-10024.1	-27958.6
0.844546	60367.55	337521.8	11864.89	-26248	-10024.1	-27958.6
0.819545	70152.08	327626.8	11864.89	-26248	-10024.1	-27958.6
0.794546	79947.58	317753.6	11864.89	-26248	-10024.1	-27958.6
0.769545	89753.02	307900.4	11864.89	-26248	-10024.1	-27958.6
0.746623	98751.7	298882	9749.115	-26248	-10024.1	-27958.6
0.744546	99567.59 108574.1	298065.4	8553.437	-26248	-10024.1	-27958.6
0.721623 0.719546	108374.1	289062.7 288247.5	-1832.52 -2575.93	-26248 -26248	-10024.1 -10024.1	-27958.6 -27958.6
0.696623	118404.6	279259.5	-2375.93 -9195.7	-26248	-10024.1	-27958.6
0.694545	119221.8	278445.6	-9673.32	-26248	-10024.1	-27958.6
0.671623	128242.7	269471.7	-13910.9	-26248	-10024.1	-27958.6
0.669546	129060.6	268659	-14214	-26248	-10024.1	-27958.6
0.664347	131107.4	266625.8	-14922.3	-26471.6	-10024.1	-27968.5
0.66431	131121.9	266611.4	-14927.1	-26474.5	-10024.1	-27968.1
0.646623	138088.2	259698.5	-16861.4	-27208	-10024.1	-27421.3
0.644545	138906.7	258887	-17046.2	-27239.3	-10024.1	-27337.7
0.639347	140955	256856.9	-17474.3	-27281.1	-10024.1	-27120.2
0.63931	140969.5	256842.5	-17477.1	-27281.2	-10024.1	-27118.7
0.621623	147940.8	249939.5	-18605.3	-27104.7	-10024.1	-26322
0.619546	148759.8	249129.2	-18708.4	-27057.3	-10024.1	-26224.7
0.614347	150809.6	247101.9	-18942.3	-26918.2	-10024.1	-25978.7
0.61431	150824.1	247087.6	-18943.8	-26917.2	-10024.1	-25976.9
0.596623	157800.3	240194.3	-19509.8	-26257.9	-10024.1	-25121.6
0.596623	157800.3	240194.3	-19509.8	-26257.9	-10024.1	-25121.6
0.594546	158619.9	239385.2	-19555.6	-26164.6	-10024.1	-25019.8
0.589347	160671	237360.7	-19653.2	-25918.8	-10024.1	-24764.1
0.58931	160685.5	237346.3	-19653.9	-25917	-10024.1	-24762.3
0.571623	167666.5	230462.6	-19823.2	-24968.6	-10024.1	-23885.1
0.569545	168486.6	229654.5	-19828.5	-24847.7	-10024.1	-23781.6
0.564347	170539.1	227632.8	-19829.4	-24537.9	-10024.1	-23522
0.56431	170553.7	227618.5	-19829.4	-24535.6	-10024.1	-23520.2
0.546623	177539.3	220744.1	-19716.7	-23416.2	-10024.1	-22634.1
0.544546	178360	219937.1	-19693	-23279.3	-10024.1	-22529.8
0.539347	180413.8	217918.1	-19625.1	-22932.6	-10024.1	-22268.7
0.53931	180428.4	217903.8	-19624.5	-22930.2	-10024.1	-22266.8
0.521623	187418.6	211038.6	-19310.4	-21716	-10024.1	-21376.9
0.519545	188239.8	210232.7	-19266	-21570.7	-10024.1	-21272.3
0.514347	190295.1	208216.4	-19148.7	-21205.1	-10024.1	-21010.4
0.51431	190309.7	208202.1	-19147.8	-21202.5	-10024.1	-21008.5
0.496623	197304.4	201346.2	-18689.5	-19944.3	-10142	-20116.7
0.494546	198126.2	200541.3	-18630.3	-19795.6	-10187.4	-20011.9
0.494546	198126.2	200541.3	-18630.3	-19795.6	-10187.4	-20011.9
0.489347	200182.8	198527.7	-18477.8	-19423 -19420.3	-10269.2	-19749.6 -19747.7
0.48931 0.478571	200197.4 204446.6	198513.5 194355.7	-18476.7 -18143.2	-19420.3	-10269.6 -10361.8	-19747.7
0.478571	207196.7	194355.7	-18143.2	-18649.8	-10361.8	-19205.5
0.471623	207196.7	190862.9	-17915.5	-18151.6	-10393.1	-18749.4
0.464347	210077	188852	-17668.2	-17631.1	-10393.1	-18486.6
0.46431	210077	188837.7	-17667	-17628.5	-10397.8	-18484.8
0.453571	214343.6	184685.6	-17007	-16863.7	-10397.8	-17941.6
0.446623	217095.5	182000.1	-17032.8	-16371.7	-10359.8	-17589.8
0.444545	217918.4	181197.5	-16955.7	-16225.1	-10350.8	-17484.6
0.439347	219977.7	179189.3	-16760.4	-15859.4	-10324.9	-17221.2
0.43931	219992.3	179175	-16759	-15856.8	-10324.7	-17219.4
0.428571	224247.1	175028.5	-16346.5	-15107.2	-10256.6	-16674.9
0.421623	227000.9	172346.7	-16073.8	-14626.6	-10203.2	-16322.2
0.419545	227824.3	171545.2	-15991.5	-14483.6	-10186	-16216.7
0.414347	229885	169539.7	-15783.9	-14127.4	-10140.4	-15952.6
0.41431	229899.6	169525.5	-15782.5	-14124.9	-10140.1	-15950.7
0.403571	234157.3	165384.7	-15347.5	-13396.4	-10035.3	-15404.5
0.396623	236912.9	162706.6	-15062.2	-12930.5	-9960.57	-15050.6
0.394546	237736.9	161906.1	-14976.3	-12792	-9937.23	-14944.7
0.389347	239798.9	159903.5	-14760.5	-12447.4	-9876.91	-14679.6
0.38931	239813.6	159889.3	-14758.9	-12444.9	-9876.47	-14677.7
0.378571	244074.2	155754.3	-14308.9	-11741.2	-9743.51	-14129.3
0.371623	246831.7	153080	-14015.2	-11291.9	-9651.84	-13773.9
0.369546	247656.2	152280.7	-13927	-11158.5	-9623.62	-13667.5

0.364347	249719.7	150280.9	-13705.8	-10826.6	-9551.39	-13401.2
0.36431	249734.3	150266.7	-13704.2	-10824.3	-9550.87	-13399.3
0.353571	253997.9	146137.7	-13244.5	-10147.3	-9394.66	-12848.2
0.346623	256757.4	143467.3	-12945.5	-9715.59	-9288.79	-12490.9
0.344546	257582.5	142669.1	-12855.9	-9587.48	-9256.43	-12384
0.339347	259647.5	140672.3	-12631.4	-9268.85	-9174.07	-12116.2
0.33931	259662.1	140658.1	-12629.8	-9266.6	-9173.48	-12114.3
0.328571	263928.8	136535.2	-12164.3	-8617.25	-8997.22	-11560
0.328571	263928.8	136535.2	-12164.3	-8617.25	-8997.22	-11560
0.321623	266690.2	133868.9	-11862.3	-8203.41	-8878.93	-11200.5
0.319545	267516	133071.9	-11771.9	-8080.65	-8842.94	-11092.9
0.314347	269582.5	131078.1	-11545.5	-7775.39	-8751.63	-10823.3
0.31431	269597.1	131064	-11543.9	-7773.24	-8750.98	-10821.4
0.303571	273866.9	126947.5	-11075.4	-7151.43	-8556.83	-10263.3
0.296623	276630.5	124285.3	-10771.9	-6755.31	-8427.36	-9901.28
0.294545	277456.9	123489.6	-10681.1	-6637.82	-8388.07	-9792.89
0.289347	279525	121499	-10081.1	-6345.72	-8288.63	-9521.33
0.28931	279539.6	121484.9	-10452.3	-6343.66	-8287.92	-9519.41
		+				
0.278571	283812.8	117375	-9982.68	-5748.76	-8077.37	-8956.99
0.271623	286578.6	114717.3	-9678.75	-5369.83	-7937.54	-8591.99
0.269546	287405.6	113922.9	-9587.88	-5257.45	-7895.2	-8482.69
0.264347	289475.3	111935.6	-9360.51	-4978.04	-7788.16	-8208.84
0.26431	289490	111921.6	-9358.9	-4976.07	-7787.4	-8206.89
0.253571	293766.7	107818.7	-8889.32	-4407	-7561.45	-7639.52
0.246623	296534.8	105165.6	-8585.59	-4044.49	-7411.83	-7271.16
0.244546	297362.6	104372.7	-8494.81	-3936.96	-7366.58	-7160.84
0.239347	299434.1	102389	-8267.68	-3669.6	-7252.31	-6884.36
0.23931	299448.8	102374.9	-8266.07	-3667.72	-7251.49	-6882.4
0.228571	303729.2	98279.54	-7797.15	-3123.06	-7010.76	-6309.38
0.221623	306499.8	95631.41	-7493.91	-2775.98	-6851.66	-5937.2
0.219546	307328.2	94839.96	-7403.28	-2673.01	-6803.59	-5825.71
0.214347	309401.7	92860.06	-7176.54	-2416.93	-6682.28	-5546.25
0.21431	309416.4	92846.03	-7174.94	-2415.12	-6681.42	-5544.27
0.203571	313700.9	88758.75	-6706.81	-1893.19	-6426.19	-4964.82
0.196623	316474.2	86116	-6404.06	-1560.39	-6257.73	-4588.29
0.194545	317303.4	85326.19	-6313.57	-1461.62	-6206.86	-4475.46
0.189347	319378.9	83350.43	-6087.15	-1215.92	-6078.54	-4192.6
0.18931	319393.7	83336.43	-6085.55	-1214.18	-6077.63	-4190.59
0.178571	323682.6	79257.97	-5617.94	-713.029	-5807.87	-3603.79
0.171623	326458.8	76621.13	-5315.4	-393.182	-5629.95	-3222.26
0.169546	327289	75833.12	-5224.94	-298.21	-5576.24	-3107.9
0.164347	329366.8	73861.95	-4998.56	-61.8437	-5440.78	-2821.11
0.16431	329381.5	73847.97	-4996.96	-60.1744	-5439.81	-2819.07
0.153571	333675.3	69779.32	-4529.14	422.4332	-5155.14	-2223.78
0.146623	336454.8	67149.1	-4226.22	730.8433	-4967.41	-1836.44
0.144546	337286.1	66363.12	-4135.61	822.4854	-4910.74	-1720.29
0.139347	339366.4	64397.11	-3908.76	1050.706	-4767.81	-1428.92
0.13931	339381.2	64383.17	-3907.15	1052.318	-4766.79	-1426.85
0.128571	343680.5	60325.67	-3437.9	1518.985	-4466.35	-821.573
0.121623	346463.9	57703.06	-3133.66	1817.754	-4268.14	-427.349
0.119546	347296.2	56919.41	-3042.6	1906.622	-4208.29	-309.073
0.114347	349379.6	54959.39	-2814.46	2128.129	-4057.28	-12.2381
0.11431	349394.4	54945.5	-2812.84	2129.695	-4056.2	-10.1292
0.103571	353700.3	50901.08	-2340.2	2583.598	-3738.49	607.1974
0.096623	356488.2	48287.51	-2033.19	2874.966	-3528.62	1009.819
0.094545	357322	47506.67	-1941.19	2961.763	-3465.19	1130.708
0.089347	359408.9	45553.87	-1710.49	3178.392	-3305.05	1434.309
0.08931	359423.8	45540.04	-1708.85	3179.925	-3303.91	1436.467
0.078571	363737.7	41511.68	-1229.76	3625.259	-2966.33	2068.927
0.071623	366531.2	38909.43	-917.604	3912.302	-2742.74	2482.311
0.069545	367366.8	38132.15	-823.891	3998.015	-2675.05	2606.589
0.064347	369458.4	36188.63	-588.516	4212.394	-2503.89	2919.056
0.06431	369473.2	36174.86	-586.843	4213.914	-2502.66	2921.279
0.053571	373797.8	32167.71	-96.0059	4657.013	-2140.38	3574.123
0.046623	376599.1	29581.02	225.6262	4944.7	-1899.04	4002.544
0.044545	377437.1	28808.72	322.5214	5030.988	-1825.72	4131.664
0.039347	379535.4	26878.52	566.6954	5247.709	-1639.65	4457.076
0.03931	379550.3	26864.85	568.4358	5249.25	-1638.31	4459.396
0.028571	383891	22890.01	1082.337	5702.366	-1240.5	5143.825
0.021623	386705.2	20329.21	1423.934	6001.778	-971.238	5597.693
0.021023	387547.7	19565.76	1527.901	6092.704	-888.479	5735.518
0.019345	389658.6	17660.74	1792.86	6324.181	-675.745	6085.792
-					-674.204	
0.01431	389673.6	17647.27	1794.767	6325.846		6088.308
0.003571	394053.9	13751.6	2378.827	6836.931	-194.244	6851.265
2.50E-04	395422.9	12575.19	2587.204	7021.72	-17.0472	7115.692

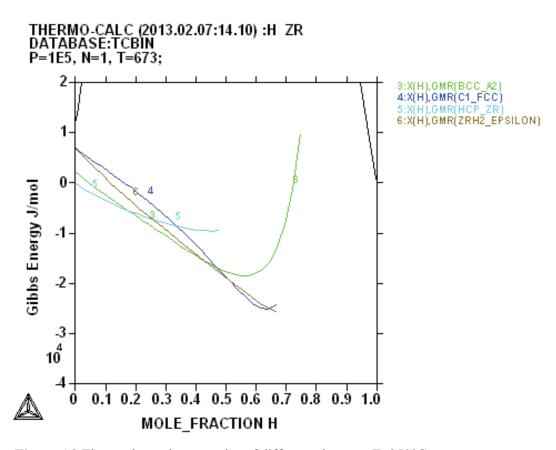


Figure A2 Thermodynamic properties of different phases at T=350°C

Table A3 Gibbs thermodynamic potentials of different phases in the Zr-H system at 400°C (in J/mole)

1003 therm		otentials of alli			<del>, -</del>	
X(H)	GMR(GAS)	GMR(IONIC_LIQ)	GMR(BCC_A2)	GMR(C1_FCC)	GMR(HCP_ZR)	GMR(ZRH2_EPS)
0.99975	91.30695	399890	11785.57	-23957.6	-8984.1	-25635.4
0.99975	91.30695	399890	11785.57	-23957.6	-8984.1	-25635.4
0.994546	2039.309	397694.3	11785.57	-23957.6	-8984.1	-25635.4
0.979762	7641.181	391594.6	11785.57	-23957.6	-8984.1	-25635.4
0.969546	11533.82	387421.9	11785.57	-23957.6	-8984.1	-25635.4
0.954762	17183.74	381418.3	11785.57	-23957.6	-8984.1	-25635.4
0.944545	21096.89	377286.7	11785.57	-23957.6	-8984.1	-25635.4
0.929762	26769.05	371327.4	11785.57	-23957.6	-8984.1	-25635.4
0.919546	30694.51	367220.4	11785.57	-23957.6	-8984.1	-25635.4
0.904762 0.894545	36381.69 40316.14	361291.3 357202.2	11785.57 11785.57	-23957.6 -23957.6	-8984.1 -8984.1	-25635.4 -25635.4
0.879762	46014.84	351296.1	11785.57	-23957.6	-8984.1	-25635.4
0.869546	49956.46	347221.4	11785.57	-23957.6	-8984.1	-25635.4
0.854762	55664.64	341334.3	11785.57	-23957.6	-8984.1	-25635.4
0.844546	59612.29	337271.7	11785.57	-23957.6	-8984.1	-25635.4
0.829762	65328.58	331400.7	11785.57	-23957.6	-8984.1	-25635.4
0.819545	69281.48	327348.6	11785.57	-23957.6	-8984.1	-25635.4
0.804762	75004.94	321492	11785.57	-23957.6	-8984.1	-25635.4
0.794546	78962.52	317449.2	11785.57	-23957.6	-8984.1	-25635.4
0.779762	84692.45	311605.5	11785.57	-23957.6	-8984.1	-25635.4
0.769545	88654.31	307571.3	11785.57	-23957.6	-8984.1	-25635.4
0.754762	94390.16	301739.5	11785.57	-23957.6	-8984.1	-25635.4
0.746623	97549.43	298531.7	9762.562	-23957.6	-8984.1	-25635.4
0.744546	98355.97	297713.2	8624.618	-23957.6	-8984.1	-25635.4
0.729762	104097.3	291892.4	1796.645	-23957.6	-8984.1	-25635.4
0.721623	107259.5	288690.4	-1233.94	-23957.6	-8984.1	-25635.4
0.719546	108066.8	287873.4	-1939.52	-23957.6	-8984.1	-25635.4
0.704762	113813.4	282063	-6280.14	-23957.6	-8984.1	-25635.4
0.696623	116978.4	278866.7	-8231.13	-23957.6	-8984.1	-25635.4
0.694545	117786.4	278051.1	-8686.04	-23957.6	-8984.1	-25635.4
0.679762	123537.9	272250.5	-11482.5	-23957.6	-8984.1	-25635.4
0.671623	126705.5	269059.4	-12733.5	-23957.6	-8984.1	-25635.4
0.669546	127514.2	268245.2	-13024.1	-23957.6	-8984.1	-25635.4
0.664347	129538	266208.2	-13704	-24191.8	-8984.1	-25669.6
0.66431	129552.3	266193.7	-13708.6	-24194.8	-8984.1	-25669.6
0.654762	133270.3	262454	-14795.2	-24740.2	-8984.1	-25500.4
0.646623	136440.5	259268.1	-15574.3	-24981.9 -25020.2	-8984.1	-25254.8 -25184.7
0.644545 0.639347	137249.9 139275.3	258455.1 256421.3	-15753.5 -16169.6	-25020.2	-8984.1 -8984.1	-25104.7
0.63931	139289.6	256406.9	-16172.4	-25081.2	-8984.1	-24998.9
0.629762	143010.6	252673.1	-16824.6	-25079	-8984.1	-24634.7
0.621623	146183.3	249492	-17278.5	-24980.6	-8984.1	-24306.4
0.619546	146993.2	248680.3	-17380.6	-24943.2	-8984.1	-24220.7
0.614347	149020.2	246649.6	-17613.6	-24830.1	-8984.1	-24003.3
0.61431	149034.5	246635.2	-17615.2	-24829.2	-8984.1	-24001.8
0.604762	152758.3	242907.1	-17964.7	-24556	-8984.1	-23593.9
0.596623	155933.4	239730.8	-18190.8	-24266.1	-8984.1	-23239.5
0.596623	155933.4	239730.8	-18190.8	-24266.1	-8984.1	-23239.5
0.594546	156744	238920.4	-18238.8	-24184.7	-8984.1	-23148.3
0.589347	158772.4	236892.7	-18343	-23969.4	-8984.1	-22918.8
0.58931	158786.8	236878.4	-18343.7	-23967.8	-8984.1	-22917.2
0.579762	162513.4	233155.8	-18479.4	-23532.7	-8984.1	-22491.8
0.571623	165690.8	229984.2	-18544.1	-23127.4	-8984.1	-22126.1
0.569545	166502	229175	-18553.7	-23019.6	-8984.1	-22032.4
0.564347	168532	227150.3	-18566.4	-22742.6	-8984.1	-21797.3
0.56431	168546.3	227135.9	-18566.4	-22740.6	-8984.1	-21795.7
0.554762	172275.7	223418.8	-18549.9	-22208.4	-8984.1	-21361.9
0.546623 0.544546	175455.4 176267.1	220251.9 219443.8	-18499.2	-21734.7	-8984.1	-20990.6 -20895.6
			-18481.3	-21611.2	-8984.1	
0.539347	178298.6	217422.1	-18428.4	-21298.3	-8984.1	-20657.6
0.53931 0.529762	178313 182045	217407.7 213696	-18428 -18302.2	-21296 -20708.3	-8984.1 -8984.1	-20655.9 -20217.6
0.521623	185227	210533.7	-18168.8	-20196.6	-8984.1	-19843
0.519545	186039.3	209726.7	-18131.1	-20196.6	-8984.1	-19747.3
0.514347	188072.2	207707.9	-18031.1	-19732.6	-8984.1	-19507.5
0.51431	188086.7	207693.6	-18030.3	-19730.2	-8984.1	-19505.8
0.504762	191821.3	203987.2	-17826	-19114.3	-8984.1	-19064.5
0.504762	191821.3	203987.2	-17826	-19114.3	-8984.1	-19064.5
0.496623	195005.7	200829.5	-17632.9	-18584.7	-9123.9	-18687.6
0.494546	195818.5	200023.7	-17581.1	-18449.1	-9180.63	-18591.3
0.494546	195818.5	200023.7	-17581.1	-18449.1	-9180.63	-18591.3
0.489347	197852.9	198007.8	-17447.1	-18109.1	-9288.11	-18350.2
0.48931	197867.3	197993.5	-17446.1	-18106.7	-9288.75	-18348.5
0.479762	201604.7	194292.5	-17185.2	-17480.7	-9416.26	-17904.8
0.478571	202070.8	193831.2	-17151.5	-17402.6	-9427.97	-17849.5
0.471623	204791.3	191139.3	-16949.3	-16946.8	-9482.63	-17526
0.469546	205604.8	190334.7	-16887.2	-16810.6	-9495.02	-17429.2
0.464347	207640.6	188321.7	-16728.9	-16470.1	-9519.26	-17186.9
0.46431	207655	188307.4	-16727.7	-16467.7	-9519.4	-17185.1

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DAMSGE  21588   BENGAT   150905   151914   59615   16386   16386   16386   16495   151914							
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0.48871 2218092 1748851 155945 130877 346676 151818 0.418515 225983 1778811 1519945 131876 746676 151819 0.418515 225983 1779815 1779818 151319 131876 746676 151819 0.418515 225983 1779815 1779818 151319 131876 746576 151876 148575 0.418	0.43931	217449.7	178635.4			-9532.67	-16015.9
0.41962 224983 7 1719011 159945 159759 9.495579 159871 0.41467 0.41967	0.429762	221192.5	174945.1	-15582.9	-14227.6	-9503.46	-15567.7
0.41996   725518   170998   135919   135799   14595   14595   14461   0.41431   2272515   166975   165928   145978   12461   4945.66   144841   0.41431   2272515   166975   165928   146978   12461   4905.60   144841   0.40527   236977   165928   146978   12461   4905.70   14809.3   0.40572   236967   125961   160325   14695   12465   124716   4905.70   14809.3   0.40572   236967   125961   160325   14695   12455   124716   4905.70   14809.3   0.40572   236967   125967   14903.3   14033.3   14033.3   14033.3   0.9940   225905.8   161334   140979   14098.8   272719   13999.9   0.39897   277046   159348   14693   14693.8   14693.8   272719   13999.9   0.39897   277046   159348   159549   14095.9   14095.6   22239   13659.8   0.37971   246868   159549   159549   14095.8   14097.9   0.37972   246868   159549   159549   14095.8   14097.8   0.37961   24677   14776.8   14797.8   14797.8   0.37961   246677   14795.6   14177.7   14198   8873.8   12468.5   0.36961   246677   14795.6   14177.7   14198   8873.8   12468.6   0.359571   250958   146731   12725   9606.4   8893.2   12668.8   0.359572   250958   146731   12725   9606.4   8893.2   12668.8   0.359572   250958   146731   12725   9606.4   8893.2   12668.8   0.359573   250958   146731   12725   9606.4   8893.2   12668.8   0.359573   250958   146731   12725   9606.4   8893.2   12668.8   0.359571   250958   146731   12725   9606.4   8893.2   12668.8   0.359572   250958   146731   12725   9606.4   8893.2   12668.8   0.359573   250958   146939   14799.8   14799.8   0.329797   260955   146731   139057   14799.8   14799.8   0.329797   260955   146731   139057   14799.8   0.329797   260958   146939   14799.8   14799.8   0.329797   260958   146939   14799.8   14799.8   0.329797   260958   146939   14799.8   14799.8   0.329797   260958   146939   14799.8   14799.8   0.329797   260958   146939   14799.8   0.329797   260958   146939   14799.8   0.329797   260958   146939   14799.8   0.329797   260958   146939   14799.8   0.329797   260958   146939   14799.8   0.329797   260958	0.428571	221659.2	174485.1	-15541.1	-14151.5	-9498.74	-15511.8
0.41996   725518   170998   135919   135799   14595   14595   14461   0.41431   2272515   166975   165928   145978   12461   4945.66   144841   0.41431   2272515   166975   165928   146978   12461   4905.60   144841   0.40527   236977   165928   146978   12461   4905.70   14809.3   0.40572   236967   125961   160325   14695   12465   124716   4905.70   14809.3   0.40572   236967   125961   160325   14695   12455   124716   4905.70   14809.3   0.40572   236967   125967   14903.3   14033.3   14033.3   14033.3   0.9940   225905.8   161334   140979   14098.8   272719   13999.9   0.39897   277046   159348   14693   14693.8   14693.8   272719   13999.9   0.39897   277046   159348   159549   14095.9   14095.6   22239   13659.8   0.37971   246868   159549   159549   14095.8   14097.9   0.37972   246868   159549   159549   14095.8   14097.8   0.37961   24677   14776.8   14797.8   14797.8   0.37961   246677   14795.6   14177.7   14198   8873.8   12468.5   0.36961   246677   14795.6   14177.7   14198   8873.8   12468.6   0.359571   250958   146731   12725   9606.4   8893.2   12668.8   0.359572   250958   146731   12725   9606.4   8893.2   12668.8   0.359572   250958   146731   12725   9606.4   8893.2   12668.8   0.359573   250958   146731   12725   9606.4   8893.2   12668.8   0.359573   250958   146731   12725   9606.4   8893.2   12668.8   0.359571   250958   146731   12725   9606.4   8893.2   12668.8   0.359572   250958   146731   12725   9606.4   8893.2   12668.8   0.359573   250958   146939   14799.8   14799.8   0.329797   260955   146731   139057   14799.8   14799.8   0.329797   260955   146731   139057   14799.8   0.329797   260958   146939   14799.8   14799.8   0.329797   260958   146939   14799.8   14799.8   0.329797   260958   146939   14799.8   14799.8   0.329797   260958   146939   14799.8   14799.8   0.329797   260958   146939   14799.8   0.329797   260958   146939   14799.8   0.329797   260958   146939   14799.8   0.329797   260958   146939   14799.8   0.329797   260958   146939   14799.8   0.329797   260958	0.421623	224383.7	171801.1	-15294.5	-13708.7	-9466.76	-15184.9
0.414347 2272315 1589978 1-159319 1-13248-1 -9425-69 1-14840.3   0.404767 229997 15659238 1-146798 1-12467.6 -9360.79 1-14890.3   0.404767 229997 15659238 1-146798 1-12467.6 -9360.79 1-14890.3   0.404767 2214641 1548385 1-14678.7 1-1275.5 -9551-39 1-14383.2   0.30623 1-241026 1-241026 1-241038 1-14678.1 1-12428.2 -2298.83 1-14603.3   0.30623 1-241026 1-241026 1-241038 1-14678.1 1-12428.2 -2298.83 1-14603.3   0.308347 2-270461 1-15948.3 1-46178.3 1-11635.8 -2323.2 1-13659.3   0.38931 2-27066 1-15948.1 1-15948.3 1-14078.3 1-11635.8 -2323.2 1-13659.3   0.38931 2-27066 1-15948.1 1-15948.3 1-14079.9 1-11635.8 1-2422.9 1-13659.8   0.38931 2-24068.8 1-35559.0 1-35519.3 1-11135.9 -914.0 1-12559.6   0.38947 2-24068.8 1-35559.0 1-15958.3 1-11035.9 -914.0 1-12559.6   0.38947 2-24068.8 1-35559.0 1-1266.3 1-1266.2   0.36462 1-24020.7 1-51720.6 1-15402.7 1-1051.2   0.36462 1-24020.7 1-51720.6 1-15402.7 1-1051.2   0.36463 1-24020.7 1-51720.6 1-15402.7 1-1051.2   0.36546 1-24020.7 1-51720.6 1-15402.7 1-1051.2   0.35577 2-25023.1 1-46011.9 1-12751.9 9610.4   0.35577 2-25023.1 1-46011.9 1-12751.9 9610.4   0.35577 2-25023.1 1-46011.9 1-12751.9 9610.4   0.35577 2-25023.1 1-46011.9 1-12751.9 9610.4   0.35577 2-25023.1 1-46011.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 9610.4   0.35577 2-25023.1 1-14601.9 1-12751.9 1-127							
0.41431 2272515 158977.5 15929.8 1-2494.7 0 -9369.79 14389.5 0.40597.1 231461.1 164833.5 1-2458.7 12727.5 9351.93 1-3433.2 1-2459.0 0.65597.1 231461.1 164833.5 1-2459.7 12727.5 9351.93 1-3433.2 1-2459.0 0.65623 1-2450.0 12725.1 1-2459.0							
0.007872   2319641   3649335   1-0057   1-1247.6   -9360.79   1-14389.5   0.00571   2319641   3649335   1-0057   1-12112.8   -9360.79   1-14389.5   0.365623   23499.6   1-12152.4   1-1277.9   1-1011.8   -9272.9   1-3905.5   0.36542   23705.8   1-1201.8   1-1201.8   -9272.9   1-3905.5   0.36542   23705.8   1-1201.8   1-1201.8   -9272.9   1-3905.5   0.36542   23705.8   1-1201.8   1-1215.8   -923.2   1-1205.8   1-1201.8   -923.2   1-1205.8   0.3772.8   1-1201							
0.03971   2314861   1.68335   1.46357   1.1273.5   -9351.93   -1.4332.5   1.430.43   0.39646   236005.8   1.1275.4   1.4376   1.1274.8   -9926.83   1.4400.43   0.39846   236005.8   1.1515.2   1.1297.9   1.1201.8   -9272.29   1.3905.9   1.39							
0.396023   234056   1631514   -143761   -12142.8   -9266.83   -14004.3   -14004.8   -9272.9   -13965.9   -13							
0.38931   2379061   1399383   3-41013   149939   149936   9232.96   139576   139576   139576   139576   149939   149936   1923.96   139576   1395							
0.389347   227066.1   159348.3   1-1401.3   1-1695.8   2233.29   1-3859.8   0.38931   227060.0   159334.1   1-1699.9   1-1693.6   2233.29   1-3859.8   0.37957.2   24608.8   1-5556.4 9   1-1735.1   1-111.3   1-111.4   1-11.4   1-1203.8   1-1	0.396623	234190.6	162153.4	-14376.1	-12142.8	-9296.83	-14004.3
0.38931   23700.6   159334   1.46999   1.1693.6   9.232.96   1.3607.6   0.37972   24008.8   15556.9   0.17751   1.1113.5   9.914.04   1.2203.8   0.378671   241276.3   1.5556.3   1.15893   1.1041.7   9.128.94   1.3147.1   0.17163   24400.8   1.5520.4   1.140.8   1.062.5   0.055.5   1.2816   0.0595.6   24480.7   1.5170.6   1.1340.2   1.0695.2   0.055.5   1.2816   0.0595.6   24480.7   1.5170.6   1.1340.2   1.0591.2   0.052.7   1.2716.0   0.0503.2   24602.7   1.47179.6   1.1317.7   1.0193   0.8673.8   1.2865.3   1.2	0.394546	235005.8	161352.4	-14297.9	-12014.8	-9279.29	-13905.9
0.37871 2412763 1551063 138893 1-11011.7 1-912.894 1-1203.8 1551063 138893 1-1101.7 1-912.894 1-1203.8 1551063 13893 1-1101.7 1-912.894 1-1203.8 1-	0.389347	237046.1	159348.3	-14101.3	-11695.8	-9233.29	-13659.3
0.37871 2412763 1551063 138893 1-11011.7 1-912.894 1-1203.8 1551063 138893 1-1101.7 1-912.894 1-1203.8 1551063 13893 1-1101.7 1-912.894 1-1203.8 1-	0.38931	237060.6	159334.1	-14099.9	-11693.6	-9232.96	-13657.6
0.378571   244176.3   155196.3   1.1889.3   -1.1041.7   -9.128.94   -1.3147.1   0.3766.3   24400.8   15220.4   -1.3402.8   -1.0052.5   -0.905.5   -1.2816   0.38946   24480.7   151720.6   -1.3140.2   -1.0501.2   -9.093.7   -1.2712.0   -1.2816.3							
0.375623   244800.8   132520.4   13120.6   13130.2   10501.2   9055.55   13121.6   13130.2   10501.2   9032.72   12716.9   0.364347   246862.5   149719.6   13137.7   10193   8973.88   14248.5   14268.5   0.36431   24607.7   14970.5   1313.6   10190.8   8973.45   14266.8   0.354762   250628.1   14603.19   142715   9660.84   8859.12   14266.8   0.354762   250628.1   14603.19   142715   9660.54   8859.12   14266.8   0.354571   25109.59   1455741   147215   9660.57   8854.31   14263.6   14263.8   14263.							
0.369546							
0.364347   246862.5   14971.9.6   1.13137.7   1.10133   4973.8.8   1.12468.5     0.364362   250628.1   146931.9   1.2761.9   9.630.84   4889.12   1.2009.6     0.35377   251095.9   145574.1   1.2715   9.630.84   4889.12   1.2009.6     0.35377   251095.9   145574.1   1.2715   9.630.84   4889.12   1.2009.6     0.35373   251095.9   145574.1   1.2715   9.630.84   4889.12   1.1009.6     0.35373   251086.2   14390.3   1.2240.6   9.1937.6   4875.5.8   1.1018.9     0.34466.2   25464.3   1410.3   1.2258.3   9.600.44   48728.29   1.1519     0.339347   256686.4   1.010.6   1.2151.9   4743.54   4865.5   1.1268.7     0.33931   25670.0   1400.91.9   1.2150.4   4743.54   4865.5   1.1268.7     0.329762   25605.5   13624.2   1.1769.8   4207.31   4850.3   1.000.6     0.329762   25605.5   13624.2   1.1769.8   4207.31   4850.3   1.000.6     0.328571   2609231   139507.1   1.1722.2   4115.66   4507.2   1.0784.1     0.34031   25605.5   13399.8   1.1414.9   7.786.07   4800.0   4.000.6   4.0411.3     0.31437   2605.5   13399.8   1.1160.6   7.788.31   4.000.6   4.0411.3     0.31437   2605.3   13399.3   1.150.6   7.788.31   4.000.6   4.0411.3     0.31437   2605.3   13099.8   1.1860.6   7.788.31   4.000.6   4.000.6   4.000.6     0.340762   27028.8   12682.4   1.0765.5   4.0828.4   4.12.9   9.931.6     0.340762   27028.8   12682.4   1.0765.5   4.0828.4   4.12.9   9.931.6     0.340762   27038.8   12697.5   1.000.5   4.000.6   4.000.6   4.000.6     0.38397   270538   12697.5   1.000.5   4.000.6   4.000.6   4.000.6     0.38397   270538   1.2679.6   1.000.7   4.000.6   4.000.6   4.000.6     0.38397   270538   1.2679.6   1.000.5   4.000.6   4.000.6   4.000.6     0.283947   270538   1.2679.6   1.000.5   4.000.6   4.000.6   4.000.6     0.283947   270538   1.2679.6   1.000.6   4.000.6   4.000.6   4.000.6     0.283947   270538   1.2679.6   1.000.6   4.000.6   4.000.6   4.000.6     0.283947   270538   1.2679.6   1.000.6   4.000.6   4.000.6   4.000.6     0.283947   270538   1.200.6   4.000.6   4.000.6   4.000.6   4.000.6     0.283947   270548   1.1							
0.34371 246877 149705.5 1.1316.3 1.0190.8							
0.534762   2506281   146631.9   12761.9   9600.84   8899.12   1.2009.6   0.35371   251095.9   145574.1   1.2715   9561.57   8884.31   1.1952.5   0.36623   253826.5   142902.3   1.2440.6   9159.76   875.58   1.1618.9   0.339347   256686.4   1.4010.6   1.2151.9   8743.54   8658.5   1.1268.7   0.339347   256686.4   1.4010.6   1.2151.9   8743.54   8658.5   1.1268.7   0.339347   256686.4   1.4010.6   1.2151.9   8743.54   8658.5   1.1268.7   0.339347   256686.4   1.4010.6   1.2151.9   8743.54   8658.5   1.1268.7   0.33937   25600.9   1.40091.9   1.2150.4   8741.44   8658   1.1266.9   0.329762   260455   13624.2   1.1769.8   8202.31   8524.35   1.0806   0.328571   260923.1   135967.1   1.1722.2   8135.66   8507.2   1.0748.4   0.328571   260923.1   135967.1   1.1722.2   4135.66   8507.2   1.0748.4   0.328571   260923.1   135967.1   1.1722.2   4135.66   8507.2   1.0748.4   0.328571   260923.1   13500.5   1.1360.5   7634.32   8373.84   1.0311.1   0.314347   266518.2   130068   1.1151.6   7348.81   8294.38   1.0056.8   0.34872   270298.8   126823.7   130493.9   1.1150.2   7346.79   8393.81   1.0056.8   0.34872   270298.8   126823.4   1.0056.6   0.30571   270798.3   1.26376   1.07475   4.764.8   8.123.7   9.531.55   0.30672   273494.4   123713.2   1.0163.8   6.262.7   7.974.69   9.090.20   0.288347   270538   1.2065.6   0.30571   270758   1.2065.5   1.0065.8   0.288347   270538   1.2065.6   0.30571   270758   1.2065.5   1.0065.8   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   1.2065.6   0.288347   270538   0.2865.6   0.2865.7   0.2865.7   0.2865.7   0.2865.7   0.2865.7   0.2865.7   0.2865.7   0.2865.7   0.2865.7   0.2865	0.364347	246862.5	149719.6	-13137.7	-10193	-8973.88	-12468.5
0.348571   251095.9   1465741   -12715   -9561.57   -884.31   -11952.5   -1362.23   -12840.6   -256403   -1283.83   -13618.9   -13	0.36431	246877	149705.5	-13136.3	-10190.8	-8973.45	-12466.8
0.345371   251095.9   1455741   -12715   -9561.57   -3844.31   -11952.5   0.34636   253826.5   14520.3   -12440.6   -9159.76   -3755.58   -11618.9   0.344546   254643   142103.8   -12383.8   -900.04   -3728.2   -11151.9   -11519   -3755.58   -1168.7   -11519   -3755.58   -1168.7   -11519   -3755.58   -1168.7   -11519   -3755.58   -1168.7   -11519   -3755.58   -1168.7   -11519   -11519   -3755.58   -1168.7   -11519   -11519   -3755.58   -1168.7   -11519   -	0.354762	250628.1	146031.9	-12761.9	-9630.84	-8859.12	-12009.6
0.346623   25387.5   14290.23   1.1240.6   9.115.76   8.755.58   1.1618.9     0.3494.6   236443   14210.8   1.2258.3   9.000.44   8.732.29   1.1519     0.339347   256686.4   1401.06   1.1251.9   8.743.54   8.658.5   1.1268.7     0.33931   25670.0   140091.9   1.2150.4   8.741.44   8.868.6   1.1266.9     0.329762   256985.4   13642.2   1.1768.8   8.202.31   8.524.35   1.0806.0     0.328571   260923.1   135967.1   1.1722.2   8.135.66   8.507.2   1.0788.4     0.328571   260923.1   13399.1   1.1722.2   8.135.66   8.507.2   1.0788.4     0.328572   260923.1   13399.1   1.1722.2   8.135.66   8.507.2   1.0788.4     0.32623   263655.9   13329.8   1.1443.9   7.749.07   8.805.06   1.011.9     0.319545   264473.1   132502.5   1.1360.5   7.684.32   8.373.84   1.0311.1     0.319437   266518.2   130508   1.1151.6   7.348.81   8.2924.38   1.0086.8     0.34347   266518.2   130508   1.1151.6   7.748.79   8.293.81   1.0086.8     0.334762   270288.8   12683.7   1.1076.5   6.828.54   8.842.59   9.951.6     0.303571   270758.3   126376   1.0777.5   6.628.54   8.842.59   9.951.6     0.303571   270758.3   126376   1.0777.5   6.628.54   8.842.59   9.953.55     0.296545   274311.2   122917.3   1.0352.8   6.282.7   7.974.69   9.902.06     0.28931   7.67638   1.20626.3   1.1042.4   6.008.42   7.7886.44   8.832.0     0.289347   7.67638   1.20626.3   1.1042.4   6.008.42   7.7886.44   8.835.6     0.289347   7.67638   1.20626.3   1.1044.9   6.006.48   7.7885.81   8.835.2     0.296546   274311.2   1.12127.1   9.7553.87   5.9568.61   7.7797.69   9.902.06     0.28931   2.02632   1.1151.5   9.795.57   5.544.07   7.697.98   8.306.7     0.276762   28013.9   11727.1   7.9753.87   5.968.61   7.7957.69   9.902.06     0.289347   2.026546   2.0213.9   1.1277.1   9.7553.87   5.968.61   7.7957.69   9.902.06     0.289347   2.026546   2.026546   1.1161.5   9.9755.7   5.544.07   7.697.98   8.306.7     0.276576   2.026547   2.026548   1.1344.4   9.939.07   4.948.2   7.7854.49   7.7856.8     0.266547   2.026547   2.026548   2.026548   2.026548   2.026548   2		251095.9			-9561.57		
0.348466 224643 142103.8 1-12558.3 9-004.04 8-728.29 1-11519.0 0.33941 256866.4 14010.6 1-121519 8-743.54 8-656.8 1-1266.9 0.33976.2 250655 13624.2 1-1763.8 8-741.44 8-865.8 1-1266.9 0.32976.2 250655 13624.2 1-1763.8 8-202.31 8-324.35 1-1080.6 0.328571 250923.1 139597.1 1-1722.2 8-135.66 8-507.2 1-10748.4 0.328571 250923.1 139597.1 1-1722.2 8-135.66 8-507.2 1-10748.4 0.328571 250923.1 139597.1 1-1722.2 8-135.66 8-507.2 1-10748.4 0.328571 250923.1 139597.1 1-1722.2 8-135.66 8-507.2 1-10748.4 0.328571 250923.1 13959.1 1-1043.9 7-749.07 8-805.06 1-10411.9 0.319545 254473.1 13220.2 5 1-1360.5 7-643.3 8-373.4 8-10311.1 0.314347 256518.2 1-1049.3 1-1056.6 1-10411.9 0.319545 254473.1 13250.2 5 1-1360.5 1-1360.5 7-643.3 8-373.48 1-10058.6 0.30476.2 0.70289.8 1-1043.9 1-1150.2 7-346.79 8-3293.8 1-10058.6 0.30476.2 0.70289.8 1-1043.9 1-1150.2 7-346.79 8-3293.8 1-10058.6 0.30476.2 0.70289.8 1-1058.3 1-1056.8 0.30476.2 0.70289.8 1-1058.3 1-1059.5 0.628.24 4 1-1075.5 0.628.24 8-1812.9 9-9591.66 0.303571 0.7058.3 1-126376 1-10717.5 0.628.24 8-1812.9 9-9591.66 0.303571 0.7058.3 1-126376 1-10717.5 0.628.24 8-1812.9 9-9591.66 0.303571 0.7058.3 1-1058.6 0.303571 0.7058.3 1-1058.6 0.303571 0.7058.3 1-1058.6 0.303571 0.7058.3 1-1058.6 0.303571 0.7058.3 1-1058.6 0.303571 0.7058.3 1-1058.6 0.303571 0.7058.3 1-1058.0 0.7058.3 1-1058.6 0.303571 0.7058.3 1-1058.0 0.7058.7 0.7058.3 1-1058.0 0.7058.7 0.7058.3 1-1058.0 0							
0.339347 256886.4 140106 -121519 87843.5 8658.5 -11268.7 0.33931 256700 9 140091.9 1.21510.4 87814.4 8858.5 -11268.0 0.328571 260923.1 1339671.4 1.1712.2 8133.66 8507.2 1.0784.8 0.328571 260923.1 1339671.4 1.1712.2 8133.66 8507.2 1.0784.8 0.328571 260923.1 1339671.4 1.1712.2 8133.66 8507.2 1.0784.8 0.328571 260923.1 13399.8 1.11712.2 8133.66 8507.2 1.0784.8 0.328571 260923.1 13399.8 1.11712.2 8133.66 8507.2 1.0784.8 0.328571 260923.1 13299.8 1.1144.9 1.7749.0 7.840.50 1.0411.9 0.33154.5 264473.1 122502.5 1.1360.5 7.7643.2 8373.84 1.0311.1 0.334347 266513.2 1300.08 1.1151.6 7.348.81 8.2924.38 1.005.6 0.34141 266512.2 1300.08 1.1151.6 7.348.81 8.2924.38 1.005.6 0.31431 266512.2 1300.98 1.1151.6 7.348.81 8.2924.38 1.005.6 0.30472 270288.8 12633.7 1.1076.5 6828.5 4 8142.9 9.991.6 0.303571 270758.3 1.26375 1.10715.5 6784.86 8.312.3 9.991.6 0.303571 270758.3 1.26375 1.10715.5 6784.88 8.312.3 9.951.8 0.0.30472 270288.8 12637.4 1.1075.5 6784.88 8.312.3 9.951.8 0.0.206.3 273493.4 122713.2 1.0358.8 6.392.9 9.800.6 4.7 9.191.8 0.0.206.3 273493.4 122713.2 1.0358.8 6.392.9 9.800.6 4.7 9.191.8 0.0.206.3 273493.4 122713.2 1.0358.8 6.392.9 9.800.6 4.7 9.191.8 0.0.206.3 273493.4 1.1151.6 1.010.9 6.006.48 1.7885.81 9.992.0 6.0.208.3 1.005.2 1.0							
0.33931   255700.9   140091.9   -1.2159.4   -8741.44   -8658   -1.1266.9   0.328571   250923.1   139967.1   -1.1722.2   8135.66   -8507.2   -1.0748.4   0.328571   260923.1   139967.1   -1.1722.2   8135.66   -8507.2   -1.0748.4   0.328571   260923.1   139967.1   -1.1722.2   8135.66   -8507.2   -1.0748.4   0.328571   260923.1   13999.1   -1.1722.2   8135.66   -8507.2   -1.0748.4   0.328571   260923.1   13999.8   -1.144.9   -7749.07   -8405.06   -1.0411.9   0.319545   264473.1   12250.5   -1.1360.5   -7634.32   -8373.84   -1.0111.0   0.314347   265518.2   13009.8   -1.151.6   -7348.81   -8294.38   -1.0058.6   0.34341   266552.7   13093.9   -1.151.6   -7348.81   -8294.38   -1.0058.6   0.34341   266552.7   13093.9   -1.150.2   -7346.79   -8293.81   -1.0058.6   0.304762   270289.8   126832.4   -1.0765.5   -6282.54   -8142.95   -9591.66   0.304762   27289.8   126832.4   -1.0765.5   -6282.54   -8142.95   -9591.66   0.304762   272493.4   122713.2   -1.049.6.8   -6282.72   -7974.69   -9092.06   0.28931   276372.5   120912.1   -1.0152.8   -6282.72   -7974.69   -9092.06   0.28931   276372.5   120912.1   -1.0142.4   -6008.42   -7886.44   -8837.06   0.28931   276372.5   120912.1   -1.0140.9   -6006.84   -7886.44   -8837.06   0.28931   276372.5   120912.1   -1.0140.9   -6006.84   -7858.64   -8835.55   0.2766.6   283157.8   1.1344.4   -9423.47   -5090.21   -7771.0   -7865.42   0.2664.7   -7865.44   -7602.81							
0.329762   260455   136424.2   -11769.8   -8202.31   -8524.35   -10006.0   -1028.24							
0.328571   260923.1   135967.1   -11722.2   8-135.66   -8507.2   -10748.4							
0.328571   260923.1   135967.1   -11722.2   8.135.66   -10748.5   -10411.9   -103194.5   -264473.1   13290.5   -1143.9   -7740/07   -8405.6   -10411.9   -103194.7   -266518.2   13290.8   -11151.6   -7348.8   -8294.8   -10011.1   -103144.7   -266518.2   13058   -11151.6   -7348.8   -8294.8   -10058.6   -10314.1   -26552.7   13049.3   -11150.2   -7346.79   -2293.8   -10056.8   -203070.2   -270283.8   12882.4   -10765.5   -6682.5 4   -8142.95   -991.66   -2030577   -270283.8   12882.4   -10765.5   -6764.8   -812.3 7   -9933.5 5   -2991.6   -2030577   -270283.8   12882.4   -10765.5   -6764.8   -812.3 7   -9933.5 5   -2991.6   -2030577   -270283.8   12892.4   -10717.5   -6764.8   -812.3 7   -9933.5 5   -2991.6   -2030577   -270283.8   -122917.3   -10352.8   -6282.7   -7946.9   -9092.0   -2030555   -274311.2   -122917.3   -10352.8   -6282.7   -7946.9   -9092.0   -2030555   -274311.2   -212917.3   -10352.8   -6282.7   -7946.9   -9092.0   -203057							
0.31953   2636559   133299.8   .11443.9   .7749.07   .8405.06   .10411.9     0.319545   264473.1   132502.5   .11360.5   .7663.42   .8373.84   .10311.1     0.314347   266518.2   .130008   .11151.6   .7348.81   .8294.38   .10008.6     0.31431   26658.2   .130908   .11150.2   .7348.7   .8293.81   .10006.8     0.304762   .270289.8   .12632.4   .10765.5   .6632.5.4   .8142.95   .9591.66     0.30571   .270758.3   .126376   .10717.5   .6764.48   .8123.7   .9531.5     0.296623   .273493.4   .12571.2   .10436.8   .6392.99   .8009.47   .9133.82     0.295454   .74511.2   .122917.3   .10352.8   .6382.72   .8009.47   .9133.82     0.285447   .276558   .10265.3   .10142.4   .6008.42   .7886.44   .8867.06     0.28931   .276572   .28012.2   .11757.1   .1040.9   .6006.48   .7885.81   .8685.25     0.276762   .28012.2   .11757.1   .9753.87   .5508.61   .77791.6   .8685.43     0.276572   .28013.2   .11757.1   .4753.87   .5508.61   .77791.6   .8685.43     0.276546   .284157.8   .113349   .94334   .94334   .5000.21   .7572.57   .77654.4     0.26431   .28620.9   .111367.5   .9127.7   .4720.7   .7484.0   .7608.8     0.26431   .28620.9   .111367.5   .9127.8   .4718.9   .7534.49   .7608.8     0.26431   .28620.9   .111367.5   .9127.8   .4718.9   .7735.8   .7755.8   .7705.8     0.256576   .2899846   .107699.1   .8737.84   .4200.5   .7555.8   .7715.9     0.26431   .290454   .10744.4   .8689.38   .4181.42   .7232.8   .7605.8   .7715.9     0.256772   .2899846   .107699.1   .8737.84   .4200.5   .7555.8   .7715.9     0.256371   .290454   .10744.4   .8689.38   .4181.42   .7232.8   .7606.8   .7715.9     0.26431   .290454   .10744.4   .8689.38   .4181.42   .7232.8   .7605.8   .7605.8     0.256772   .2899846   .107699.1   .8737.84   .4200.5   .7555.8   .7715.9   .7609.8     0.256772   .2899846   .107699.1   .8737.84   .4200.5   .7555.8   .7605.8   .7715.9     0.246523   .29319.3   .04663.8   .3838.7   .7606.8   .7606.8   .7606.8   .7606.8   .7715.9   .7715.9   .7715.9   .7715.9   .7715.9   .7715.9   .7715.9   .7715.9   .7715.9   .7715.9   .7715.	0.328571	260923.1	135967.1	-11722.2	-8135.66	-8507.2	-10748.4
0.319545   264471   132502.5   -11360.5   -7634.32   -8373.84   -10311.1     0.31434   266512   130508   -11151.6   -7348.81   -8294.38   -10058.6     0.31431   26652.7   12099.9   -11150.2   -7346.79   -8291.81   -10056.8     0.30571   27078.3   126376   -10717.5   -6764.48   -8412.95   -9591.66     0.30571   27078.3   126376   -10717.5   -6764.48   -8412.7   -9531.55     0.296623   273491.4   123713.2   -1036.8   -6392.99   -8009.47   -9193.82     0.29945   274911.2   122917.3   -10352.8   -6282.72   -7736.69   -9052.06     0.289347   276358   12092.6   -10147.4   -6008.42   -7886.44   -8837.06     0.28931   276372.5   120912.1   -10140.9   -6006.48   -7838.81   -8383.70     0.278762   280132.9   117257.1   -9753.87   -5508.61   -7719.16   -8365.43     0.278771   28000.18   116801.5   -9705.57   -5447.07   -7697.98   -8306.72     0.269346   284157.8   113349   -93330.07   -4984.29   -7334.49   -7660.58     0.269341   286206.4   111361.5   -9127.77   -4720.77   -7433.04   -7602.81     0.264347   286206.4   111361.5   -9127.77   -4720.77   -7437.34   -7760.28     0.264623   28998.6   107699.1   -8737.84   -420.56   -7255.89   -7125.92     0.239371   290454   107244.4   -8889.38   -4181.4   -4720.78   -7665.65     0.246623   23919.9   10591.3   -8466.49   -3883.4   -420.56   -7255.89   -7125.92     0.239347   29606.8   10181.8   -8109.96   -3483.33   -6951.4   -655.97     0.226572   29898.6   0.9769.1   -8737.84   -3736.65   -7056.67   -6651.22     0.239447   29606.8   10181.8   -8109.96   -3483.33   -6951.4   -655.97     0.226572   29898.6   0.9769.1   -8737.84   -3406.64   -3405.66   -750.52   -5615.27     0.229762   29898.5   0.985.6   9.985.9   -7719.12   -3021.54   -675.99   -5719.27     0.226571   200905.3   10180.7   -8108.46   -3481.44   -675.49   -566.66   -575.52     0.229762   29898.5   0.985.6   9.985.9   -7799.1   -7799.2   -7865.8   -7799.7     0.216447   30593.08   -7865.8   -7799.8   -7799.2   -7865.8   -7799.7     0.216467   -7998   -7999.8   -7799.8   -7799.8   -7799.8   -7799.8   -7799.8   -	0.328571	260923.1	135967.1	-11722.2	-8135.66	-8507.2	-10748.4
0.314347   266518.2   130698   -11151.6   -7348.81   -8294.38   -10058.6   0.304762   270288.8   12683.4   -10765.5   -6828.54   -8142.95   -9511.66   0.304762   270288.8   12683.4   -10765.5   -6828.54   -8142.95   -9511.66   0.30571   270758.3   126376   -10717.5   -6764.48   -813.7   -9533.55   0.296623   273493.4   123713.2   -1043.6   -6392.99   -8009.47   -9393.82   0.294545   273491.2   122917.3   -10352.8   -6282.72   -7974.69   -9092.06   0.289347   276372.5   120912.1   -10144.4   -6008.42   -7368.4   -8387.06   0.289347   276372.5   120912.1   -10144.9   -6006.48   -7368.81   -8383.52   0.279762   280132.9   117257.1   -9753.87   -5508.61   -7719.16   -8365.43   0.278571   280001.8   116801.5   -9705.57   -5447.07   -7697.98   -8306.72   -2012.2   -2012	0.321623	263655.9	133299.8	-11443.9	-7749.07	-8405.06	-10411.9
0.314347   266518.2   130698   -11151.6   -7348.81   -8294.38   -10058.6   0.304762   270288.8   12683.4   -10765.5   -6828.54   -8142.95   -9511.66   0.304762   270288.8   12683.4   -10765.5   -6828.54   -8142.95   -9511.66   0.30571   270758.3   126376   -10717.5   -6764.48   -813.7   -9533.55   0.296623   273493.4   123713.2   -1043.6   -6392.99   -8009.47   -9393.82   0.294545   273491.2   122917.3   -10352.8   -6282.72   -7974.69   -9092.06   0.289347   276372.5   120912.1   -10144.4   -6008.42   -7368.4   -8387.06   0.289347   276372.5   120912.1   -10144.9   -6006.48   -7368.81   -8383.52   0.279762   280132.9   117257.1   -9753.87   -5508.61   -7719.16   -8365.43   0.278571   280001.8   116801.5   -9705.57   -5447.07   -7697.98   -8306.72   -2012.2   -2012	0.319545	264473.1	132502.5	-11360.5	-7634.32	-8373.84	-10311.1
0.31431   2655327   130493.9   -11150.2   -7346.79   -8293.81   -1.0056.8   0.303571   270758.3   126832.4   -1.0765.5   -688.84   -8142.95   -9951.66   0.303571   270758.3   126376   -1.0717.5   -6764.48   -8123.7   -9533.55   0.296523   273493.4   123713.2   -1.0358.8   -6392.99   -8009.47   -9193.82   0.29455   274311.2   122917.3   -1.0358.8   -6382.72   -7746.69   -9902.06   0.289347   276358   120926.3   -1.0142.4   -6008.42   -7886.44   -8837.06   0.28934   276372.5   120912.1   -1.0140.9   -6006.48   -7886.44   -8837.06   0.28931   276372.5   120912.1   -1.0140.9   -6006.48   -77858.81   -8835.25   0.27976.2   280132.9   117257.1   -9753.87   -5508.61   -7719.16   -8365.43   0.278571   280601.8   116801.5   -9705.57   -5447.07   -7697.98   -8306.72   0.271623   283339.2   11443.4   -9423.47   -5000.21   -7572.57   -7763.42   0.264347   286206.4   111361.5   -9127.77   -4720.77   -7438.04   -77602.81   0.264347   286206.4   111361.5   -9127.77   -4720.77   -7438.04   -77602.81   0.26431   286220.9   111347.5   -9126.28   -4718.9   -7437.35   -7600.98   0.254762   289984.6   107699.1   -8737.64   -4240.56   -7255.89   -7125.92   0.255571   290454   10244.4   -8689.38   -4181.42   -7232.88   -7066.54   0.266623   29313.9   104591.3   -8466.43   -3383.47   -7066.88   -6719.27   0.229374   29606.8   101814.8   810.99   -3483.3   -6950.66   -6552.2   0.239347   29606.8   101814.8   810.99   -3483.3   -6950.66   -6552.2   0.239347   29606.8   10184.8   810.99   -3483.3   -6950.66   -6553.52   0.229562   29984.6   0.9819.59   -7719.12   -301.154   -6950.66   -6553.52   -6551.99   -7719.12   -7719.12   -7719.12   -7719.12   -7719.12   -7719.12   -7719.12   -7719.13   -7719.14   -7719.14   -7719.15   -7719.14   -7719.15							
0.304762   270289.8   12682.4   -10765.5   -6828.54   -8142.95   -9591.65     0.303571   270788.3   126376   -10717.5   -6764.48   -8123.7   -9593.55     0.296623   273493.4   123713.2   -10436.8   -6392.99   -8009.47   -9193.82     0.28947   276558   120926.3   -10142.4   -6008.42   -7886.44   -8857.06     0.289347   276558   120926.3   -10142.4   -6008.42   -7886.44   -8857.06     0.289347   276572.5   120912.1   -10140.9   -6006.48   -7885.81   -8835.65     0.279762   280132.9   117257.1   -9753.87   -5508.61   -7719.16   -3856.43     0.278571   280601.8   116801.5   -9705.57   -5447.07   -7697.98   -8306.72     0.278572   280339.2   114143.4   -9423.47   -5090.21   -7572.57   -7563.42     0.269546   284157.8   113349   -9339.07   -4984.29   -7534.49   -7560.58     0.26431   286220.9   111347.5   -9126.28   -4718.9   -7437.35   -7600.98     0.253571   290454   10724.4   -8689.38   -4181.42   -7232.88   -7125.92     0.253571   290454   10724.4   -8689.38   -4181.42   -7232.88   -7066.54     0.26622   29113.9   105951.3   -8006.41   -3838.47   -7006.88   -6719.27     0.244546   294013.2   103798.4   -8221.8   -3736.65   -7055.67   -6615.22     0.293447   296063.8   101814.8   -8121.8   -3736.65   -7055.67   -6615.22     0.29347   299665.6   98155.9   -7719.12   -3021.54   -6734.99   -5847.6     0.24562   299103.9   105951.3   -8006.49   -3483.33   -6951.4   -6554.37     0.293947   299663.8   101814.8   -8121.8   -3736.65   -7055.67   -6615.22     0.29347   299685.6   98155.9   -7719.12   -3021.54   -6734.99   -5847.6     0.228571   300315.4   97705.81   97005.89   -7889.9   -7889.9   -7889.9   -7889.9     0.214347   305990.8   92287.31   -7005.5   -2964.66   -6553.97   -5597.7     0.19347   305990.8   92287.31   -7005.5   -2964.66   -6593.99   -5615.24     0.21643   303985.1   9506.09   -7889.92   -2292.84   -6427.85   -5090.09   -7889.97     0.13647   315808.1   9506.09   -7889.99   -5615.4   -4627.05   -5608.09     0.10654   332339.7   -7566.84   -7595.5   -7566.39   -5615.24   -3249.24     0.116431   3325							
0.303571   270758.3   126376   -10717.5   -6764.48   -8122.7   -9533.55     0.296523   273493.4   123713.2   -1036.8   -6392.99   -8009.47   -9193.82     0.29455   274311.2   122917.3   -10552.8   -6282.72   -7974.69   -9020.06     0.289347   276558   120925.3   -10142.4   -6008.42   -7886.44   -88857.05     0.289347   276558   120921.1   -10140.9   -6006.48   -7886.51   -7885.51   -7885.75     0.299762   280132.9   11257.1   -9753.87   -5508.61   -7719.16   -8365.43     0.78577   280601.8   116801.5   -9705.57   -544.707   -7697.98   -8306.72     0.271623   283339.2   11443.4   -9423.47   -5090.21   -7572.57   -7963.42     0.209346   284157.8   113349   -933.007   -4984.29   -7572.57   -7963.42     0.209346   284157.8   113349   -933.007   -4984.29   -7572.57   -7963.42     0.209346   284157.8   11349   -933.007   -4984.29   -7572.57   -7963.42     0.264347   286206.4   111361.5   -9177.77   -4720.77   -7438.04   -7602.81     0.26431   28620.9   111347.5   -9126.28   -4718.9   -7437.35   -7600.89     0.254762   289984.6   107691.1   -8737.84   -4240.56   -7255.89   -7125.92     0.253571   290454   107244.4   -86893.8   -4181.42   -7232.88   -7066.54     0.26632   293193.9   104591.3   -8406.43   -8383.47   -7066.88   -6795.27     0.246546   294013.2   103798.4   -8321.8   -3736.65   -7055.67   -6615.22     0.23931   296078.3   101814.8   -8109.96   -3483.33   -6554.4   -6584.37     0.228571   300315.4   97708.81   -7670.59   -2964.66   -6730.22   -58811.8     0.228571   300315.4   97708.81   -7670.59   -2964.66   -6730.22   -5881.9     0.228571   300315.4   97708.81   -7670.59   -2964.66   -6730.22   -5881.9     0.228571   300315.6   -8828.39   -7719.12   -3021.54   -6950.66   -6352.52     0.23931   296078.3   101800.7   -8108.46   -3481.54   -6990.66   -6352.52     0.23931   296078.3   101800.7   -8108.46   -3481.54   -6990.66   -6352.52     0.23931   296078.3   10180.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0   -7860.0							
0.296623         273493.4         123713.2         -10436.8         -6392.99         -8009.47         -9193.82           0.29347         276358         12026.3         -10142.4         -6008.42         -7786.44         -8857.06           0.28931         276372.5         120912.1         -10140.9         -6006.48         -7885.81         -8835.25           0.279762         280132.9         117257.1         -9753.87         -5508.61         -719.16         -8855.23           0.279572         280123.9         117257.1         -9753.87         -5508.61         -719.16         -8855.23           0.279572         280601.8         116801.5         -9705.57         -5447.07         -7697.98         -8306.72           0.271623         283339.2         114343.4         -9423.47         -5909.21         -7572.57         -7963.42           0.269447         28615.8         113349         -9339.07         -4984.29         -753.49         -7860.58           0.26431         286220.9         111347.5         -9126.28         -4718.9         -7437.35         -7600.98           0.254762         289984.6         107944.4         -8689.38         -4818.42         -7905.88         -7705.59           0.244546							
0.284545         274311.2         112917.3         -10352.8         -6282.72         .7974.69         -9092.06           0.28931         276372.5         120912.1         -10140.9         -6006.48         -7885.81         -8837.06           0.279762         280132.9         117257.1         -9753.87         -5508.61         .7719.16         -3865.25           0.278571         280601.8         116801.5         -9705.57         -5447.07         -7697.98         -8306.72           0.271623         283339.2         114143.4         -9423.47         -5000.21         -7572.57         -7963.42           0.264347         286206.4         111361.5         -9102.77         -4720.77         -7438.04         -7600.81           0.264347         286206.4         111347.5         -9126.28         -4718.9         -7437.35         -7600.98           0.254762         289984.6         107699.1         -8737.84         -420.06         -7255.89         -7125.92           0.246623         293193.9         104591.3         -8466.43         -3838.47         -7096.88         -6719.27           0.24456         29417.7         -9266.8         10181.8         -8109.96         -8338.47         -7096.88         -6792.27							
0.289347         276358         1.0026.3         -1014.2.4         -6008.42         .7885.6.4         -8837.05           0.28931         276372.5         1.2091.2.1         -1014.0.9         -6006.48         -7885.81         -8835.25           0.27962         280132.9         117257.1         -9753.87         -5508.61         -7719.16         -8365.43           0.271623         283339.2         114143.4         -9423.47         -5090.21         -7572.57         -7963.42           0.269546         284157.8         113349         -9339.07         -4984.29         -753.4.49         -7860.58           0.26431         286220.9         1111347.5         -9127.77         -4720.77         -7438.04         -7602.81           0.254762         289984.6         107699.1         -873.84         -4240.56         -7255.89         -7125.92           0.25371         290454         107244.4         -6669.38         -4181.42         -7222.88         -7066.54           0.24652         293193.9         104591.3         -8406.43         -383.47         -7096.88         -6719.27           0.239347         296063.8         10181.4         -810.99.6         -3483.3         -6951.4         -6352.52           0.239347							
0.28931	0.294545	274311.2	122917.3	-10352.8	-6282.72	-7974.69	-9092.06
0.279762 280132.9 117257.1 -9753.87 -5508.61 -7719.16 -8365.43   0.278571 280601.8 116801.5 -9705.57 -5447.07 -7697.98 -8306.72   0.271623 283339.2 114434.4 -9423.47 -5090.21 -7572.57 -7963.48   0.269546 284157.8 113349 -9339.07 -4984.29 -7534.49 -7860.58   0.264347 286206.4 111361.5 -9127.77 -4748.04 -7602.81   0.26431 286220.9 111347.5 -9126.28 -4718.9 -7437.35 -7600.98   0.254762 28998.6 107699.1 -8737.84 -4240.56 -7255.89 -7125.92   0.253571 290454 107244.4 -8689.38 -4181.42 -7232.88 -7066.54   0.24652 293193.9 104591.3 -8406.43 -3383.47 -7096.88 -6719.27   0.244546 294013.2 103798.4 -8321.8 -3736.65 -7055.67 -6615.22   0.239347 296063.8 101814.8 -8109.96 -3483.33 -6951.4 -6354.37   0.23931 296078.3 101800.7 -8108.46 -3481.54 -6950.66 -6352.52   0.229762 29984.5 -9815.99 -7719.12 -3021.54 -6754.99 -5871.46   0.228571 300315.4 97705.81 -7670.55 -2964.66 -6730.22 -5811.48   0.21263 303058.1 9508.09 -7387 -2634.69 -6583.99 -5459.77   0.214547 305930.8 92287.31 -7609.92 -2536.7 -6539.72 -5354.36   0.214347 305930.8 92287.31 -7089.92 -2292.84 -6427.85 -5090.06   0.214341 305945.3 92273.28 -7088.41 -2491.11 -6427.05 -5088.19   0.204762 309716.5 88639.87 -6698.26 -1848.05 -6217.46 -4600.72   0.204762 309716.5 88639.87 -6698.26 -1848.05 -6217.46 -4600.72   0.204762 309716.5 88639.87 -6698.26 -1848.05 -6217.46 -4600.72   0.189347 315808.1 82780.6 -6606.07 -1143.74 -5867.88 -3800.09   0.14347 305930.8 92287.31 -6369.2   0.195623 31292.3 85545.17 -6366.7 -1793.7 -5363.49 -3490.00   0.19454 315808.1 82780.6 -6606.07 -1143.74 -5867.88 -3900.6   0.19454 315808.1 82780.6 -6606.07 -1143.74 -5867.88 -3800.09   0.19562 319598.1 7914.6 -6606.07 -1143.74 -5867.88 -3800.09   0.19562 319598.1 7914.6 -6606.07 -1143.74 -5867.88 -3800.09   0.19564 33233.3 8257.1 6066.0 -6730.22 -5536.6 -6608.07 -1143.74 -5867.39 -3806.03   0.19564 33233.3 82571.6 6368.26 -6606.07 -1143.74 -5867.39 -3806.03   0.19562 332317.7 6064.4 -6506.0 -6606.07 -1143.74 -5867.39 -3806.03   0.19564 33263.7 7566.84 -5525.9 8 -662.95 -5615.24 -3249.24   0.116347 3	0.289347	276358	120926.3	-10142.4	-6008.42	-7886.44	-8837.06
0.279762         280132.9         117257.1         -9753.87         -5508.61         -7719.16         4365.43           0.278571         280601.8         116801.5         -9705.57         -5447.07         -7697.98         -8306.72           0.271623         283339.2         114143.4         -9423.47         -5090.21         -572.57         -7963.42           0.264347         286206.4         111361.5         -9127.77         -478.00         -7534.09         -7860.58           0.26431         28620.9         111347.5         -9126.28         -4718.9         -7437.35         -7600.98           0.254762         28998.6         107699.1         -8737.84         -4240.56         -7255.89         -7125.92           0.253571         290454         107244.4         -8689.38         -4814.12         -723.88         -7066.54           0.246623         293193.9         104591.3         -8406.43         -3838.47         -7096.88         -6719.27           0.239347         296063.8         101814.8         -810.99         -3483.33         -6951.4         -6354.37           0.239347         296063.8         101810.8         -810.99         -3483.33         -6951.4         -6354.37           0.239347         2	0.28931	276372.5	120912.1	-10140.9	-6006.48	-7885.81	-8835.25
0.278571   280601.8   116801.5   -9705.57   -5447.07   -7697.98   -8306.72	0.279762	280132.9	117257.1	-9753.87		-7719.16	-8365.43
0.271623         283339.2         114143.4         -9422.47         5-509.21         -7572.57         -7963.42           0.269546         284157.8         113349         -9339.07         -4984.29         -7534.49         -7860.58           0.26437         286206.4         111361.5         -9127.77         -7438.04         -7602.81           0.26476         289984.6         107699.1         -8737.84         -4240.56         -7255.89         -7125.92           0.253571         290454         107244.4         -8689.38         -4181.42         -7232.88         -7066.54           0.24652         2393193.9         104591.3         -8406.43         -3338.47         -7066.88         -6719.27           0.246546         294013.2         103798.4         -8321.8         -3736.65         -7055.67         -6615.22           0.239347         296063.8         101814.8         -810.99.6         -3483.33         -6951.4         -6354.37           0.239547         296063.8         101810.7         -8108.46         -8491.4         -695.66         -6352.52           0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.21633         3003058.1		+					
0.269546         2841578         113349         -9330.07         -4998.29         -7534.49         -7860.58           0.264347         286206.4         111361.5         -9127.77         -4720.77         -7438.04         -7602.81           0.26431         28620.9         111347.5         -9126.28         -4718.9         -7437.35         -7600.98           0.254762         289984.6         107699.1         -8737.84         -4240.56         -7255.89         -7125.92           0.235751         290454         107744.4         -8889.38         -4181.42         -723.28         -7066.54           0.246623         293193.9         104591.3         -8406.43         -3383.47         -7096.88         -6719.27           0.244546         294013.2         103798.4         -8321.8         -3736.65         -7055.67         -6615.22           0.23931         296078.3         10180.07         -8108.46         -3481.54         -6950.66         -6352.52           0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -7670.55         2964.66         -6730.22         -5811.48           0.219434 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>							
0.264347   28620.64   111361.5   -912.777   -4720.77   -7438.04   -7602.81							
0.26431         286220.9         111347.5         -9126.28         -4718.9         -7437.35         77600.98           0.254762         289984.6         107699.1         -8737.84         -4240.56         -7255.89         -7125.92           0.253571         290454         107244.4         -8689.38         -4181.42         -7232.88         -7066.54           0.246623         293193.9         104591.3         -8406.43         -3338.47         -7096.88         -6719.27           0.244546         294013.2         103798.4         -8321.8         -3736.65         -7055.67         -6615.22           0.239347         296063.8         101814.8         -810.996         -3483.33         -6951.4         -6354.37           0.23931         296078.3         101800.7         -8108.46         -3481.54         -6950.66         -6352.52           0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -760.55         -2964.66         -6730.22         -5811.48           0.21432         30368.1         95058.09         -7387         -263.67         -6539.72         -5354.36           0.21433         30							
0.254762 289984.6 107699.1 -8737.84 -4240.56 -7255.89 -7125.92   0.253571 290454 107244.4 -8689.38 -4181.42 -7232.88 -7066.54   0.246623 293193.9 104591.3 -8406.43 -3838.47 -7096.88 -6719.27   0.244546 294013.2 103798.4 -8321.8 -3736.65 -7055.67 -6615.22   0.239347 296063.8 101814.8 -8109.96 -3483.33 -6951.4 -6354.37   0.239311 296078.3 101800.7 -8108.46 -3481.54 -6950.66 -6352.52   0.229762 299845.6 98159.59 -7719.12 -3021.54 -6754.99 -5871.61   0.228571 300315.4 97705.81 -7670.55 -2964.66 -6730.22 -5811.48   0.221623 303058.1 95058.09 -7387 -2634.69 -6583.99 -5489.77   0.219546 303878.2 94266.8 -7302.2 -2536.7 -6539.72 -5354.36   0.214347 305930.8 92287.31 -7089.92 -2292.84 -6427.85 -5090.06   0.21431 305945.3 92273.28 -7088.41 -2291.11 -6427.05 -5088.19   0.204762 309716.5 88639.87 -6698.26 -1888.05 -6217.46 -4600.72   0.203571 310186.8 88187.07 -6649.59 -1793.24 -6199.96 -4539.75   0.194545 313753.3 84755.64 -6280.39 -1380.66 -5987.32   0.18931 31582.7 8276.62 -6066.07 -1143.74 -5867.03   0.18931 31582.7 82766.62 -6066.07 -1143.74 -5867.03   -3807.94 -4076.12   0.18931 31582.7 82766.62 -6066.07 -1143.74 -5867.03   -3808.99 -7382.2   0.16634 33257.1 7944.66 -5674.8 -715.951 -5643.49   -3311.16 -5654.3   0.179762 319598.1 7944.66 -5674.8 -715.951 -5643.49   -3311.16 -56674.8 -715.951 -5643.49   -3311.16 -7382.81 -5000.33   -7382.81 -5000.33   -7382.81 -5000.33   -7382.81 -5000.33   -7382.81 -5000.33   -7382.81 -5000.33   -7382.91 -7382.91 -7392.94   -7382.91 -7382.91   -7382.91 -7382.91   -7382.91 -7382.91   -7382.91 -7382.91   -7382.91 -7382.91   -7382.91							
0.253571         290454         107244.4         -8689.38         -4181.42         -7232.88         -7066.54           0.246623         293193.9         104591.3         -8406.43         -3838.47         -7096.88         -6719.27           0.244546         294013.2         103798.4         -8321.8         -3736.65         -7055.67         -6615.22           0.239347         296063.8         101814.8         -8109.96         -3483.33         -6951.4         -6354.37           0.23931         296078.3         101800.7         -8108.46         -3481.54         -6950.66         -6352.52           0.229672         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -7670.55         -2964.66         -6730.22         -5811.48           0.21623         303058.1         95088.09         -7387         -2634.69         -6589.72         -5354.36           0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         <	0.26431	286220.9	111347.5	-9126.28	-4718.9	-7437.35	-7600.98
0.246623         293193.9         104591.3         -8406.43         -3838.47         -7096.88         -6719.27           0.244546         294013.2         103798.4         -8321.8         -3736.65         -7055.67         -6615.22           0.239347         296063.8         101814.8         -810.96         -3483.33         -6951.4         -6354.37           0.23931         296078.3         101800.7         -8108.46         -3481.54         -6950.66         -6352.52           0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -7670.55         -2964.66         -6730.22         -5811.48           0.221623         303058.1         95058.09         -7387         -2634.69         -6583.99         -5459.77           0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5988.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.03571	0.254762	289984.6	107699.1	-8737.84	-4240.56	-7255.89	-7125.92
0.244546         294013.2         103798.4         -8321.8         -3736.65         -7055.67         -6615.22           0.239347         296068.8         101814.8         -8109.96         -3483.33         -6951.4         -6354.37           0.23931         296078.3         101800.7         -8108.46         -3481.54         -6950.66         -6335.25           0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -7670.55         -2964.66         -6730.22         -5811.48           0.221623         303058.1         95058.09         -7387         -634.69         -683.99         -5459.77           0.219546         303878.2         94266.8         -7302.2         -2536.7         -6539.72         -5354.36           0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305930.8         92287.31         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.19623	0.253571	290454	107244.4	-8689.38	-4181.42	-7232.88	-7066.54
0.244546         294013.2         103798.4         -8321.8         -3736.65         -7055.67         -6615.22           0.239347         296068.8         101814.8         -8109.96         -3483.33         -6951.4         -6354.37           0.23931         296078.3         101800.7         -8108.46         -3481.54         -6950.66         -6335.25           0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -7670.55         -2964.66         -6730.22         -5811.48           0.221623         303058.1         95058.09         -7387         -634.69         -683.99         -5459.77           0.219546         303878.2         94266.8         -7302.2         -2536.7         -6539.72         -5354.36           0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305930.8         92287.31         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.19623	0.246623	293193.9	104591.3	-8406.43	-3838.47	-7096.88	-6719.27
0.239347         296063.8         101814.8         -8109.96         -3483.33         -6951.4         -6354.37           0.23931         296078.3         101800.7         -8108.46         -3481.54         -6950.66         -6352.52           0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -7670.55         -2964.66         -6730.22         -5811.48           0.221623         303058.1         95058.09         -7387         -2634.69         -6583.99         -5459.77           0.219546         303878.2         94266.8         -7302.2         -2536.7         -6539.72         -5354.36           0.214347         305930.8         922873.11         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1888.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.59         -1793.24         -6190.96         -4539.75           0.19623		294013.2					
0.23931         296078.3         101800.7         -8108.46         -3481.54         -6950.66         -6352.52           0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -7670.55         -2964.66         -6730.22         -5811.48           0.221623         303058.1         95058.09         -7387         -2634.69         -6583.99         -5459.77           0.219546         303878.2         94266.8         -7302.2         -2536.7         -6539.72         -5354.36           0.214347         305930.8         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.59         -1793.24         -6190.96         -4539.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545							
0.229762         299845.6         98159.59         -7719.12         -3021.54         -6754.99         -5871.61           0.228571         300315.4         97705.81         -7670.55         -2964.66         -6730.22         -5811.48           0.221623         303058.1         95058.09         -7387         -2634.69         -6583.99         -5459.77           0.219546         303878.2         94266.8         -7302.2         -2536.7         -6539.72         -5354.36           0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.59         -1793.24         -6190.96         -4539.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -628.39         -1380.66         -5987.32         -4076.12           0.194545							
0.228571         300315.4         97705.81         -7670.55         -2964.66         -6730.22         -5811.48           0.221623         303058.1         95058.09         -7387         -2634.69         -6583.99         -5459.77           0.219546         303878.2         94266.8         -7302.2         -2536.7         -6539.72         -5354.36           0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.59         -1793.24         -6190.96         -4539.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315802.7         82766.62         -6067.58         -1145.4         -5867.03         -380.60           0.179762         <							
0.221623         303058.1         95058.09         -7387         -2634.69         -6583.99         -5459.77           0.219546         303878.2         94266.8         -7302.2         -2536.7         -6539.72         -5354.36           0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.59         -1793.24         -6190.96         -4539.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82786.62         -6067.58         -1145.4         -5867.88         -3807.94           0.18931         31582.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>							
0.219546         303878.2         94266.8         -7302.2         -2536.7         -6539.72         -5354.36           0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.59         -1793.24         -6190.96         -4539.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82780.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623							
0.214347         305930.8         92287.31         -7089.92         -2292.84         -6427.85         -5090.06           0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.99         -1793.24         -6190.96         -4539.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82780.62         -6065.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         32069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.16434							
0.21431         305945.3         92273.28         -7088.41         -2291.11         -6427.05         -5088.19           0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.59         -1793.24         -6190.96         -4539.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82780.62         -6067.58         -1145.4         -5867.88         -3807.94           0.18931         315822.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347	0.219546	303878.2	94266.8	-7302.2	-2536.7	-6539.72	-5354.36
0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.99         -1793.24         -6190.96         -4339.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82780.62         -6067.58         -1145.4         -5867.88         -3807.94           0.18931         315822.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.16431	0.214347	305930.8	92287.31	-7089.92	-2292.84	-6427.85	-5090.06
0.204762         309716.5         88639.87         -6698.26         -1848.05         -6217.46         -4600.72           0.203571         310186.8         88187.07         -6649.99         -1793.24         -6190.96         -4339.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82780.62         -6067.58         -1145.4         -5867.88         -3807.94           0.18931         315822.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.16431	0.21431	305945.3	92273.28	-7088.41	-2291.11	-6427.05	-5088.19
0.203571         310186.8         88187.07         -6649.59         -1793.24         -6190.96         -4539.75           0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82780.62         -6067.58         -1145.4         -5867.88         -3807.94           0.18931         315822.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.154762         <							
0.196623         312932.3         85545.17         -6365.4         -1475.16         -6034.61         -4183.05           0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82780.62         -6067.58         -1145.4         -5867.88         -3807.94           0.18931         315822.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.154762 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>							
0.194545         313753.3         84755.64         -6280.39         -1380.66         -5987.32         -4076.12           0.189347         315808.1         82780.62         -6067.58         -1145.4         -5867.88         -3807.94           0.18931         315822.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         325711.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.154623 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>							
0.189347         315808.1         82780.62         -6067.58         -1145.4         -5867.88         -3807.94           0.18931         315822.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         32281.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         32571.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.153571         329963.1         69216.73         -4589.19         430.9154         -5002.35         -1937.33           0.146623							
0.18931         315822.7         82766.62         -6066.07         -1143.74         -5867.03         -3806.03           0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         32571.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.14946 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>							
0.179762         319598.1         79141.66         -5674.8         -715.951         -5643.49         -3311.16           0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         325711.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         <							
0.178571         320069         78689.95         -5625.98         -662.995         -5615.24         -3249.24           0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         325711.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.154371         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.129762	-						
0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         325711.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571	0.179762	319598.1	79141.66	-5674.8	-715.951	-5643.49	-3311.16
0.171623         322817.7         76054.43         -5340.82         -355.532         -5448.68         -2886.88           0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         325711.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571	0.178571	320069	78689.95	-5625.98	-662.995	-5615.24	-3249.24
0.169546         323639.7         75266.84         -5255.5         -264.137         -5398.32         -2778.22           0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         325711.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608	0.171623						
0.164347         325697         73296.77         -5041.84         -36.471         -5271.16         -2505.61           0.16431         325711.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -200.33           0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.13931         335613.2         63824.55         -4009.02         1040.81         -4635.44         -1178.09           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608							
0.16431         325711.6         73282.81         -5040.33         -34.8622         -5270.25         -2503.68           0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.13931         335613.2         63824.55         -4009.02         1040.81         -4635.44         -1178.09           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608							
0.154762         329491.7         69667.25         -4647.26         379.5681         -5032.4         -2000.33           0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.13931         335613.2         63824.55         -4009.02         1040.81         -4635.44         -1178.09           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608							
0.153571         329963.1         69216.73         -4598.19         430.9154         -5002.35         -1937.33           0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.13931         335613.2         63824.55         -4009.02         1040.81         -4635.44         -1178.09           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608							
0.146623         332715.4         66588.36         -4311.44         729.2496         -4825.19         -1568.46           0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.13931         335613.2         63824.55         -4009.02         1040.81         -4635.44         -1178.09           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608	-						
0.144546         333538.5         65802.97         -4225.6         818.0032         -4771.63         -1457.79           0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.13931         335613.2         63824.55         -4009.02         1040.81         -4635.44         -1178.09           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608	-						
0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.13931         335613.2         63824.55         -4009.02         1040.81         -4635.44         -1178.09           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608	0.146623	332715.4	66588.36	-4311.44	729.2496	-4825.19	-1568.46
0.139347         335598.6         63838.48         -4010.55         1039.246         -4636.41         -1180.07           0.13931         335613.2         63824.55         -4009.02         1040.81         -4635.44         -1178.09           0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608	0.144546	333538.5	65802.97	-4225.6	818.0032	-4771.63	-1457.79
0.13931     335613.2     63824.55     -4009.02     1040.81     -4635.44     -1178.09       0.129762     339398.6     60219.66     -3612.98     1444.165     -4382.47     -664.886       0.128571     339870.7     59770.52     -3563.49     1494.2     -4350.51     -600.608	-						
0.129762         339398.6         60219.66         -3612.98         1444.165         -4382.47         -664.886           0.128571         339870.7         59770.52         -3563.49         1494.2         -4350.51         -600.608							
0.128571 339870.7 59770.52 -3563.49 1494.2 -4350.51 -600.608							
U.121623   342627.1   57150.36   -3274.16   1785.192   -4162.02   -224.089							
	0.121623	342627.1	57150.36	-3274.16	1785.192	-4162.02	-224.089

0.114347         345514.8         54409.48         -2970.15         2088.113         -3961.07         172.7288           0.11431         345529.4         54395.6         -2968.61         2089.643         -3960.05         174,7458           0.104762         349321.1         50803.22         -2567.77         2484.752         -3690.53         699.7466           0.103571         349794.1         50355.69         -2517.63         2533.846         -3656.46         765.5588           0.096623         352555.4         47745.31         -2224.14         2819.769         -3455.38         1151.348           0.094545         353381.2         46965.46         -2136.1         2905.065         -3394.52         1267.256           0.08931         355468.1         45015.26         -1915.15         3118.202         -3240.7         1558.50           0.079762         359262.4         4124.39         -1505.08         3510.368         -2951.09         2100.276           0.078871         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.02           0.076945         363331.6         37604.73         -1063.47         3928.016         -2638.64         2565.52           0.076945							
0.11431         345529.4         54395.6         -2968.61         2089.643         -3960.05         174.7456           0.104762         349321.1         50803.22         -2567.77         2484.752         -3690.53         699.7466           0.103571         349794.1         50355.69         -2517.63         2533.846         -3656.46         765.558           0.096623         352555.4         47745.31         -2224.14         2819.769         -3455.38         1151.344           0.094545         353381.2         46965.46         -2136.1         2905.065         -3394.52         1267.256           0.089347         35548.4         45015.26         -1915.15         3118.202         -3240.7         1558.50           0.08931         355463.1         45001.44         -1913.58         3119.711         -3239.61         1560.57           0.079762         35926.4         41424.39         -1505.08         3510.368         -2951.09         2100.276           0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.02           0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.62           0.069347	0.119546	343451.5	56367.49	-3187.47	1871.86	-4105.03	-111.062
0.104762         349321.1         50803.22         -2567.77         2484.752         -3690.53         699.7466           0.103571         349794.1         50355.69         -2517.63         2533.846         -3656.46         765.5587           0.096623         352555.4         47745.31         -2224.14         2819.769         -3455.38         1151.348           0.094545         353381.2         46965.46         -2136.1         2905.065         -3394.52         1267.256           0.089347         355448.4         45015.26         -1915.15         3118.202         -3240.7         1558.50           0.08931         355463.1         45001.44         -1913.58         3119.711         -3239.61         1560.57           0.079762         359262.4         41424.39         -1505.08         3510.368         -2951.09         2100.276           0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.02           0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.62           0.069545         36331.6         37604.73         -1063.47         3928.016         -2633.18         26852.44           0.064367	0.114347	345514.8	54409.48	-2970.15	2088.113	-3961.07	172.7289
0.103571         349794.1         50355.69         -2517.63         2533.846         -3656.46         765.588           0.096623         352555.4         47745.31         -2224.14         2819.769         -3455.38         1151.348           0.094545         353381.2         46965.46         -2136.1         2905.065         -3394.52         1267.26           0.089347         355448.4         45015.26         -1915.15         3118.202         -3240.7         1558.50           0.08931         355463.1         45001.44         -1913.58         3119.711         -3239.61         1560.57           0.079762         359262.4         41424.39         -1505.08         3510.368         -2951.09         2100.276           0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.02           0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.62           0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.24           0.06431         365418.5         35650.8         -835.021         4142.278         -2466.28         2988.34           0.054762         3	0.11431	345529.4	54395.6	-2968.61	2089.643	-3960.05	174.7458
0.096623         352555.4         47745.31         -2224.14         2819.769         -3455.38         1151.348           0.094545         353381.2         46965.46         -2136.1         2905.065         -3394.52         1267.256           0.089347         355448.4         45015.26         -1915.15         3118.202         -3240.7         1558.501           0.08931         355463.1         45001.44         -1913.58         3119.711         -3239.61         1560.572           0.079762         359262.4         41424.39         -1505.08         3510.368         -2951.09         2100.276           0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.023           0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.623           0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.24           0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         2986.2           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.035571	0.104762	349321.1	50803.22	-2567.77	2484.752	-3690.53	699.7462
0.094545         353381.2         46965.46         -2136.1         2905.065         -3394.52         1267.256           0.089347         355448.4         45015.26         -1915.15         3118.202         -3240.7         1558.501           0.08931         355463.1         45001.44         -1913.58         3119.711         -3239.61         1560.572           0.079762         359262.4         41424.39         -1505.08         3510.368         -2951.09         2100.276           0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.023           0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.623           0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.244           0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         2986.2           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.694           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.044545         <	0.103571	349794.1	50355.69	-2517.63	2533.846	-3656.46	765.5587
0.089347         355448.4         45015.26         -1915.15         3118.202         -3240.7         1558.503           0.08931         355463.1         45001.44         -1913.58         3119.711         -3239.61         1560.572           0.079762         359262.4         41424.39         -1505.08         3510.368         -2951.09         2100.276           0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.023           0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.623           0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.244           0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         22986.3           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.694           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.046623         372479.1         29069.8         -49.3855         4870.718         -187.946         4032.09           0.039347         <	0.096623	352555.4	47745.31	-2224.14	2819.769	-3455.38	1151.348
0.08931         355463.1         45001.44         -1913.58         3119.711         -3239.61         1560.577           0.079762         359262.4         41424.39         -1505.08         3510.368         -2951.09         2100.278           0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.02           0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.62           0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.24           0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         2986.2           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.69           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.09           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.05           0.03931         37540	0.094545	353381.2	46965.46	-2136.1	2905.065	-3394.52	1267.256
0.079762         359262.4         41424.39         -1505.08         3510.368         -2951.09         2100.276           0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.02           0.071623         362503.8         38380.74         -1153.7         3843.066         -268.64         2565.62           0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.24           0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         2986.2           0.06431         365418.5         35650.8         -835.021         4142.278         -2466.28         2983.34           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.69           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.09           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.09           0.03931         375403.7	0.089347	355448.4	45015.26	-1915.15	3118.202	-3240.7	1558.501
0.078571         359736.4         40978.88         -1453.88         3559.034         -2914.55         2168.023           0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.623           0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.244           0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         2986.34           0.06431         365418.5         35650.8         -835.021         4142.278         -2466.28         2988.34           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.694           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.083           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.093           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.053           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.304           0.029762 <td< td=""><td>0.08931</td><td>355463.1</td><td>45001.44</td><td>-1913.58</td><td>3119.711</td><td>-3239.61</td><td>1560.572</td></td<>	0.08931	355463.1	45001.44	-1913.58	3119.711	-3239.61	1560.572
0.071623         362503.8         38380.74         -1153.7         3843.066         -2698.64         2565.62           0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.24           0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         2986.3           0.06431         365418.5         35650.8         -835.021         4142.278         -2466.28         2988.34           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.694           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.09           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.05           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.30           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.785           0.021623         382495	0.079762	359262.4	41424.39	-1505.08	3510.368	-2951.09	2100.276
0.069545         363331.6         37604.73         -1063.47         3928.016         -2633.18         2685.244           0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         2986.6           0.06431         365418.5         35650.8         -835.021         4142.278         -2466.28         2988.34           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.694           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.09           0.044545         373309.6         28299.19         44.6044         4957.073         -1807.92         4156.99           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.05           0.03931         375403.7         26359.75         283.4545         5178.849         -1624.78         4474.30           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.785           0.021623         38249	0.078571	359736.4	40978.88	-1453.88	3559.034	-2914.55	2168.023
0.064347         365403.8         35664.55         -836.635         4140.769         -2467.46         2986.2           0.06431         365418.5         35650.8         -835.021         4142.278         -2466.28         2983.34           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.69           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.09           0.044545         373309.6         28299.19         44.6044         4957.073         -1807.92         4156.99           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.05           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.30           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.78           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.41           0.019545         383331 <td>0.071623</td> <td>362503.8</td> <td>38380.74</td> <td>-1153.7</td> <td>3843.066</td> <td>-2698.64</td> <td>2565.621</td>	0.071623	362503.8	38380.74	-1153.7	3843.066	-2698.64	2565.621
0.06431         365418.5         35650.8         -835.021         4142.278         -2466.28         2988.342           0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.694           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.083           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.093           0.044545         373309.6         28299.19         44.6044         4957.073         -1807.92         4156.993           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.053           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.304           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.785           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.416           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.066           0.019345	0.069545	363331.6	37604.73	-1063.47	3928.016	-2633.18	2685.244
0.054762         369228         32093.96         -413.876         4534.298         -2154.2         3547.694           0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.081           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.091           0.044545         373309.6         28299.19         44.6044         4957.073         -1807.92         4156.992           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.057           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.304           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.785           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.411           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.066           0.019545         383331         19080.57         1220.26         6026.35         +887.682         5714.415           0.014347         38	0.064347	365403.8	35664.55	-836.635	4140.769	-2467.46	2986.2
0.053571         369703.3         31651.15         -360.907         4583.346         -2114.54         3618.08           0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.09           0.044545         373309.6         28299.19         44.6044         4957.073         -1807.92         4156.99           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.05           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.30           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.78           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.411           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.06           0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.415           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.452	0.06431	365418.5	35650.8	-835.021	4142.278	-2466.28	2988.342
0.046623         372479.1         29069.8         -49.3855         4870.718         -1879.46         4032.09           0.044545         373309.6         28299.19         44.6044         4957.073         -1807.92         4156.99           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.05           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.30           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.78           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.41           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.06           0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.41           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.45	0.054762	369228	32093.96	-413.876	4534.298	-2154.2	3547.694
0.044545         373309.6         28299.19         44.6044         4957.073         -1807.92         4156.995           0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.057           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.304           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.788           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.41           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.066           0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.415           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.452	0.053571	369703.3	31651.15	-360.907	4583.346	-2114.54	3618.081
0.039347         375389         26373.39         281.7625         5174.302         -1626.09         4472.057           0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.304           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.78           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.41           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.066           0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.415           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.453	0.046623	372479.1	29069.8	-49.3855	4870.718	-1879.46	4032.091
0.03931         375403.7         26359.75         283.4545         5175.849         -1624.78         4474.304           0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.785           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.411           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.066           0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.415           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.453	0.044545	373309.6	28299.19	44.6044	4957.073	-1807.92	4156.995
0.029762         379228.5         22833.52         727.8063         5580.555         -1278.99         5063.785           0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.411           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.06           0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.415           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.453	0.039347	375389	26373.39	281.7625	5174.302	-1626.09	4472.057
0.028571         379705.9         22395.01         784.1545         5631.69         -1234.66         5138.41           0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.066           0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.419           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.453	0.03931	375403.7	26359.75	283.4545	5175.849	-1624.78	4474.304
0.021623         382495.8         19841.64         1118.313         5934.24         -969.42         5580.066           0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.419           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.453	0.029762	379228.5	22833.52	727.8063	5580.555	-1278.99	5063.785
0.019545         383331         19080.57         1220.26         6026.35         -887.682         5714.419           0.014347         385424         17181.98         1480.664         6261.367         -677.052         6056.453	0.028571	379705.9	22395.01	784.1545	5631.69	-1234.66	5138.411
0.014347 385424 17181.98 1480.664 6261.367 -677.052 6056.453	0.021623	382495.8	19841.64	1118.313	5934.24	-969.42	5580.066
	0.019545	383331	19080.57	1220.26	6026.35	-887.682	5714.419
0.01431 385438.9 17168.56 1482.542 6263.061 -675.523 6058.912	0.014347	385424	17181.98	1480.664	6261.367	-677.052	6056.453
5.52.52	0.01431	385438.9	17168.56	1482.542	6263.061	-675.523	6058.912
0.004762 389299.9 13714.7 1992.044 6723.095 -254.497 6720.349	0.004762	389299.9	13714.7	1992.044	6723.095	-254.497	6720.349
0.003571 389783.9 13289.34 2060.651 6785.281 -196.658 6808.075	0.003571	389783.9	13289.34	2060.651	6785.281	-196.658	6808.079
2.50E-04 391143.2 12120.3 2269.551 6975.975 -17.4931 7070.542	2.50E-04	391143.2	12120.3	2269.551	6975.975	-17.4931	7070.542

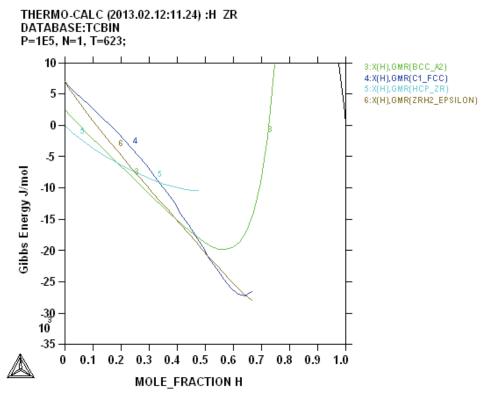


Figure A3 Thermodynamic properties of different phases at T=400°C